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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

SEPTEMBER 10-16.
International Foundry Congress:—International Foundry Congress at Prague.

SEPTEMBER 18-21.
Institute of Metals:—Silver Jubilee Autumn Meeting in Birmingham.

Will There be a Scrap Shortage?

During the last quarter of a century the following metallurgical developments have taken place which influence the demand for scrap ferrous materials. The electric furnace process has come into being, and where it manufactures material other than that previously made by crucible furnaces, it is an all-scrap process. The scrapping of the large Bessemer steel-making plants has eliminated what were virtually all-pig processes. Much of the steel previously made by this process is now made in the open-hearth furnace, which in general has been working with higher scrap charges as the years elapsed. During the period under review, the blast furnace has also become a user of steel scrap.

In the ironfoundry the cupola now absorbs more steel and iron scrap than ever before in its history, whilst the newer processes using rotary furnaces and either pulverised coal or oil as fuel are often all-scrap processes. Even the baby Bessemer is no longer an all-pig process, as large quantities of steel scrap are often employed as raw material for the cupola. Finally, many of the refined irons on the market are carefully compounded from mixtures of new and old materials. Other factors entering into the scrap position are: (1) the invention of so many rust-resisting materials; (2) the light weight of modern engineering constructions; (3) the incidence of scrap containing alloys, and (4) the growth of the Italian metallurgical industry. At one time we should have emphasised the gradual increase in the sulphur content of the world's scrap pile through constant remeltings, but by the use of soda ash this problem is easily capable of solution. All the above is a preamble to the posing of the question: "Will there be a scrap shortage with the advent of improved trading conditions?" The statements we have made certainly point to the creation of such a condition, but it is obvious that, on the other hand, improved conditions would bring about the scrapping of obsolete machinery and structures, and the material so furnished will often be of sufficient weight to make between two and one hundred replace units. The scrapping of a locomotive, for example, would make a not inconsiderable number of motor cars and lorries. The resuscitation of the basic Bessemer process is a factor of considerable importance. Thus, in attempting to appraise the situation in the future, a balance must be struck between the increased demand caused by modern metallurgical melting processes and the decreased consumption owing to the lighter character of modern engineering constructions, the conservation of industrial plant and structures through the use of better materials, coatings, and methods of maintenance.

Petrol from Coal.—II.

We did not mention in a recent issue an important national consideration affecting the petrol-from-coal scheme, in addition to its influence on our adverse trade balance; that is, its relationship to national security. It is common knowledge that in recent years naval vessels have changed from coal-burning to oil-burning, and in spite of the pressure exerted by the coal areas, notably South Wales, the Admiralty shows no tendency to revert to coal. The production of oil from coal seems likely to solve this problem in a way which should satisfy all the interests concerned, for the fuel will be derived in the first place from coal, but used as oil.

Doubtless many readers have seen accounts during the past few weeks of experiments on the running of automobiles on gas, and it seems that the development of a home-oil industry would deprive the sponsors of the use of gas of one of their major arguments, the substitution of a home fuel for an imported fuel. It is highly probable, however, that this question will be settled in the long run by technical questions having little or nothing to do with the origin of the fuel. The development of the heavy-oil engine for transport, railway work, and the general use of heavy oil in furnaces are also likely to be influenced by the new scheme.

The Government's scheme has probably been influenced by the pending exhaustion of the world's oil supplies, in spite of the comparatively low price of petrol, which at present carries no less than 8d. per gallon tax. The diversion of buying to home fuels will, of course, result in a loss of revenue to the Government of one-half of this figure. The change, however, will be slow, for we use over a thousand million gallons of petrol per annum in this country, and the scheme proposed by Imperial Chemical Industries will not produce more than 3 per cent. of this figure. If the scheme works well it is certain to be extended. The hydrogenation process yields about 50 to 60 per cent. of petrol. One hundred and fifty gallons of oil can be obtained by this process from one ton of coal. There is no other product but oil. From low-temperature carbonisation the yield of oil is much smaller, but the principal product is a smokeless, but combustible, coke, suitable for domestic or industrial use.

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Institute of British Foundrymen.

DISTRICT OFFICIALS.

The various Branches and Sections of the Institute of British Foundrymen have elected the following gentlemen as their chairmen for the forthcoming session:—

Birmingham.—Mr. E. J. Lewis, Messrs. Vowles Bros., Hall End Foundry, West Bromwich.

East Midlands.—Mr. P. A. Russell, Bath Lane, Leicester.

Lincolnshire Section.—Mr. J. Stone, "Mariland," 25, Hykeham Road, Lincoln.

Lancashire.—Mr. A. Phillips, 1, Melfort Avenue, off Edge Lane, Stretford, Manchester.

Burnley Section.—Mr. J. Taylor, 3, Tremellen Street, Accrington.

Preston Section.—Mr. W. West, The Farington Steel Works, Leyland Motors, Limited, Leyland, Lancs.

London.—Mr. C. H. Kain, Messrs. Lake & Elliot, Limited, Braintree, Essex.

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Scottish.—Mr. J. Currie, 1, Sutherland Crescent, Bathgate, West Lothian.

Falkirk Section.—Mr. T. Shanks, "Beechfield," Denny.

Sheffield.—Mr. W. T. Kitching, Messrs. Newton, Chambers & Company, Limited, Thorncliffe, Sheffield.

Wales and Monmouth.—Mr. W. E. Clement, Morfa Foundry, New Dock, Llanelly, Carmarthenshire.

West Riding of Yorkshire.—Mr. R. D. Welford, 1, Hilton Road, Frizinghall, Bradford.

Catalogue Received.

Industrial Measuring and Recording Instruments.—Messrs. Negretti & Zambra, of 38, Holborn Viaduct, London, in a 20-page brochure, describe and illustrate, using simple language and clearly-produced pictures, a wide range of pyrometers, draft gauges and pressure recorders. We think that page 20 requires a little more explanatory matter. It is obviously useful to those who have installed this firm's instruments for ordering replace parts. Moreover, information as to the nature of thermocouples incorporated in the Le Chatelier type of pyrometer would have been welcomed. However, this does not pretend to be a text book, and it has well achieved its purpose in emphasising the workmanship incorporated in their instruments and their policy of service after sales. We strongly recommend our readers to request the firm to furnish them with a copy for reference purposes.

Iron and Steel Production.

The National Federation of Iron and Steel Manufacturers in their statistical bulletin for June state that production of pig-iron showed a further slight improvement in June, the output amounted to 345,600 tons compared with 339,900 tons in May, an increase of about 5 per cent. when the number of working days is taken into account. In spite of the incidence of the Whitsun holidays, steel production (at 568,800 tons) was only 30,800 tons less than in May and exceeded production in June last year by over 100,000 tons.

Miss Tierney, who has had charge of the office of the Dorrator Iron Company, Limited, for 15 years, was the recipient of a writing bureau and cheque on the occasion of her marriage, the presentation being made by Mr. J. B. McTurk, general manager, on behalf of the staff, employees and directors.

District Presidents.—No. 1.

INSTITUTE OF BRITISH FOUNDRYMEN, SCOTTISH BRANCH.

Mr. John Currie, President of the Scottish Branch, has been a member of the Institute since 1924. At that time the Branch contained very few members who were associated with the steel foundry, and Mr. Currie was not long in helping to fill the gap by bringing in a few additional members from that side of the industry. He became a member of the Council in 1928, and will be the first member of the Branch to reach the Presidential Chair whose experience has been confined to the steel foundry.

He is a native of Bathgate, and has served all his industrial life in his native town, as

Mr. John Currie.

apprentice, works chemist, and now as chief metallurgist, with the North British Steel Foundry, Limited. He holds the first-class final certificate in the City and Guilds examination in Iron and Steel Manufacture, and for approximately ten years he has taught classes in science and strength of materials for the foundry and engineering courses, under the local Education Authority. Opportunities have come his way to go elsewhere, but Mr. Currie has so far resisted these appeals, and still finds in the North British Steel Foundry scope for his metallurgical and foundry experience.

German Ironfounding Employers' Federation.

The annual meeting of the German Ironfounding Employers' Association will take place at Potsdam, Berlin, on September 8 and 9 next. A meeting of the Scrap Buying Company formed by the Federation will be held on the morning of September 8, which will be followed in the afternoon by the general meeting of German ironfounders, at which a Paper will be read with the picturesque title of "Cast Iron on the Defence and on the Attack." The principal meeting will take place during the morning of Saturday, September 9, the preliminary session being private. A general invitation to attend the conference has been extended to all interested in the iron-founding industry. Further particulars may be obtained from the Secretary of the Federation at 50-52, Pempelforterstrasse, Düsseldorf.

Random Shots.

How Are You, Sproston's Foundry Company?

In the correspondence columns of the newspapers one reads (or does not read, according to inclination) the oddest things at times. "Marksman" has been following in "The Times" the correspondence on the subject of "Slaves' Names," and in one of the letters came across an anecdote that is almost too good to be true. Here, word for word, let "Marksman" reproduce it:—"The most extraordinary name to come under my notice is that given to the child of a workman employed at a foundry. The father had been promoted to the position of foreman, and he attained to such a lofty sense of the importance of the business in which he was so shining a light that when his wife presented him with a son he resolved to perpetuate in his family the name of the all-important firm, and in due course the infant was christened 'Sproston's Foundry Company.'"

* * *

"Marksman" is pleased to be able to include in "Random Shots" this week one from the General Secretary of the Institute of British Foundrymen, who writes:—"I commend your suggestion that an official album of informal snapshots, taken at conventions and other gatherings, be arranged, and I should be very glad to fall in with the suggestion made by 'Multi-Convenor,' that this album be kept in the possession of the General Secretary at the offices in Manchester. I am sure that the members who have negatives of such photographs would be glad to contribute to this album, and I shall be delighted to prepare prints of the very large number of photographs which I have taken at various meetings. It must be definitely understood, however, that neither the Institute of British Foundrymen nor the General Secretary can accept any liability for the consequences.

* * *

"The album can be inspected at various conferences, and, of course, will be available at the general office. I anticipate that, in the near future, this album will rank with Belle Vue, the Ship Canal, the world-famous shower baths and those other attractions which are making Manchester so increasingly popular as a health and holiday resort. I agree with 'Multi-Convener's' suggestion that the photographs be enlarged to uniform size, but I should like to be able to assure the hon. treasurer of the Institute that the Institute will not have to bear the cost. Have you any suggestions in this connection?"

* * *

It seems to "Marksman," in connection with the last sentence of the General Secretary's letter, that the best way to go about things would be first to decide upon a standard size of photographic print. Anybody wishing to submit photographs for inclusion in the album could then have them prepared to conform to the required dimensions before sending them along.

* * *

Cupola-Stage Whisper.

"I dunno how this next melt'll turn out, Jimmy. That's the second ginger-beer bottle you've thrown through the charge hole this morning."

* * *

Two ghillies were discussing the merits of a bishop who had been salmon fishing in the Highlands.

"He's a very nice gentleman, he is," said one, "but he do swear something dreadful."

"Swear! And him a bishop?"

"Aye," said the first. "A salmon started to rise, and I asked him, 'Shall I row after that —— fush, m'lord?' and he said, 'Yes, do!'"

Marksman.

Malleable Annealing Practice with Special Reference to Continuous Plants.

By J. Fallon (Managing Director, Incandescent Heat Company, Limited).

Despite the many improvements claimed from the production of high-duty grey irons and the smaller type of steel castings, and the competition from machine forging and pressing of steel parts, the useful and economic sphere of application of malleable-iron castings of both black-heart and white-heart remains unimpaired. Actually, the industry is likely to grow as the British consumption per head is lower than in any other of the important manufacturing countries.

The application of more scientific methods of production, the great precision and accuracy with which complex shapes can be produced in malleable and easily-machinable form, its relatively high-tensile strength, ductility, cleanliness of casting surfaces, resistance to corrosion, freedom from blow-holes and other defects, coupled with its dependability when produced under conditions of scientific control, have established this material as one of the most important in the engineering and metallurgical industries.

It is not intended in this article to deal with chemical, metallurgical and physical characteristics of the material, which may be produced from crucible, cupola, air furnace or electric furnace. All of these methods are in use in this country and supply the peculiar or special requirements of the various industries. It is sufficient to state that malleable castings may be divided into two main categories, *i.e.*, low-sulphur type, produced from crucible, air furnace or electric furnace, requiring annealing temperatures ranging from 800 to 850 deg. C., and being termed black-heart; and the higher sulphur type, following the Réaumur process and termed white-heart, in which the annealing process is carried out at a higher temperature, *i.e.*, exceeding 920 deg. C., which is, in fact, a decarburisation process.

It will be appreciated that the difference in temperature and time required in the two classes of castings, *i.e.*, black-heart and white-heart, has an important bearing on the method used and the form of annealing plant generally. In the black-heart process, for instance, it being unnecessary to decarburise, the form of packing material may be relatively inert, whereas in the white-heart process the carbon is removed, due to the oxidising effect of the packing material, which is usually pin-sized hematite ore.

Handling Operations.

The production of malleable castings necessitates a wide range of operations, including sand preparation, core making, melting, removal of complex castings hot from the mould and slow cooling or muffling, barrelling, sand blasting, grinding, careful packing in cast cans to prevent distortion; and for the chemical reactions, as in the case of white-heart, annealing, cooling, discharging, barrelling or sand blasting, grinding if not done in the hard state, straightening, etc.—in fact, it has been computed that the production of one ton of malleable castings necessitates the handling of approximately 100 tons of material.

It will be appreciated, therefore, that the methods of handling play a very important part in the economic production of malleable castings.

The annealing process, according to the class of casting, may vary from three days to eight days; for instance, light fittings, such as are made in the Walsall district, conduit couplings, etc., if of the correct composition, may be readily annealed in three days, whereas the heavier type engineering castings can usually be annealed within eight days. The practice in the handling for annealing of the same class of casting varies widely, cylindrical cans being favoured by some works and square boxes by others.

Early Types of Ovens.

The early type of malleable oven, which is still in use, consists of a firebrick chamber having a long firebox or trough of fire along the sides and sometimes in the centre of the chamber, located below the bed of the chamber proper, the gases arising vertically between the tiers or stacks of cans. This type of oven does not give exact control, but reasonably good results can be obtained in the hands of a skilled fireman. Modifications of this type with separate small fireboxes located around the sides, and sometimes at the back of the oven are also in general use. In many of these ovens the work is stacked in the oven by hand in a similar manner to the methods prevailing in many pottery ovens; in fact, a large number of ovens have been built after the style of pottery ovens, *i.e.*, circular beehive type.

It naturally follows that unless some means of packing outside the oven is adopted the pans are often tilted over and spilt into the oven proper, which involves at a minimum the loss of the castings in that can and those above it, and may involve other tiers. This practice has, however, been improved somewhat by packing the tiers or stacks outside the oven and then charging by some form of balanced charging fork, this method enabling the load to be removed from the oven in a heated condition, thus preventing the cooling of the oven with each charge. A considerable saving in certain foundries in this country and abroad has been effected by the charging-fork method, amounting in some instances to two days, with a corresponding economy in fuel costs.

This type of oven has been further improved by recuperation and the more scientific methods of firing and regulation of gas flow and withdrawal between the charges. These effects have all been designed to economise labour and fuel, and produce greater uniformity, as one of the curses of the malleable industry has been the

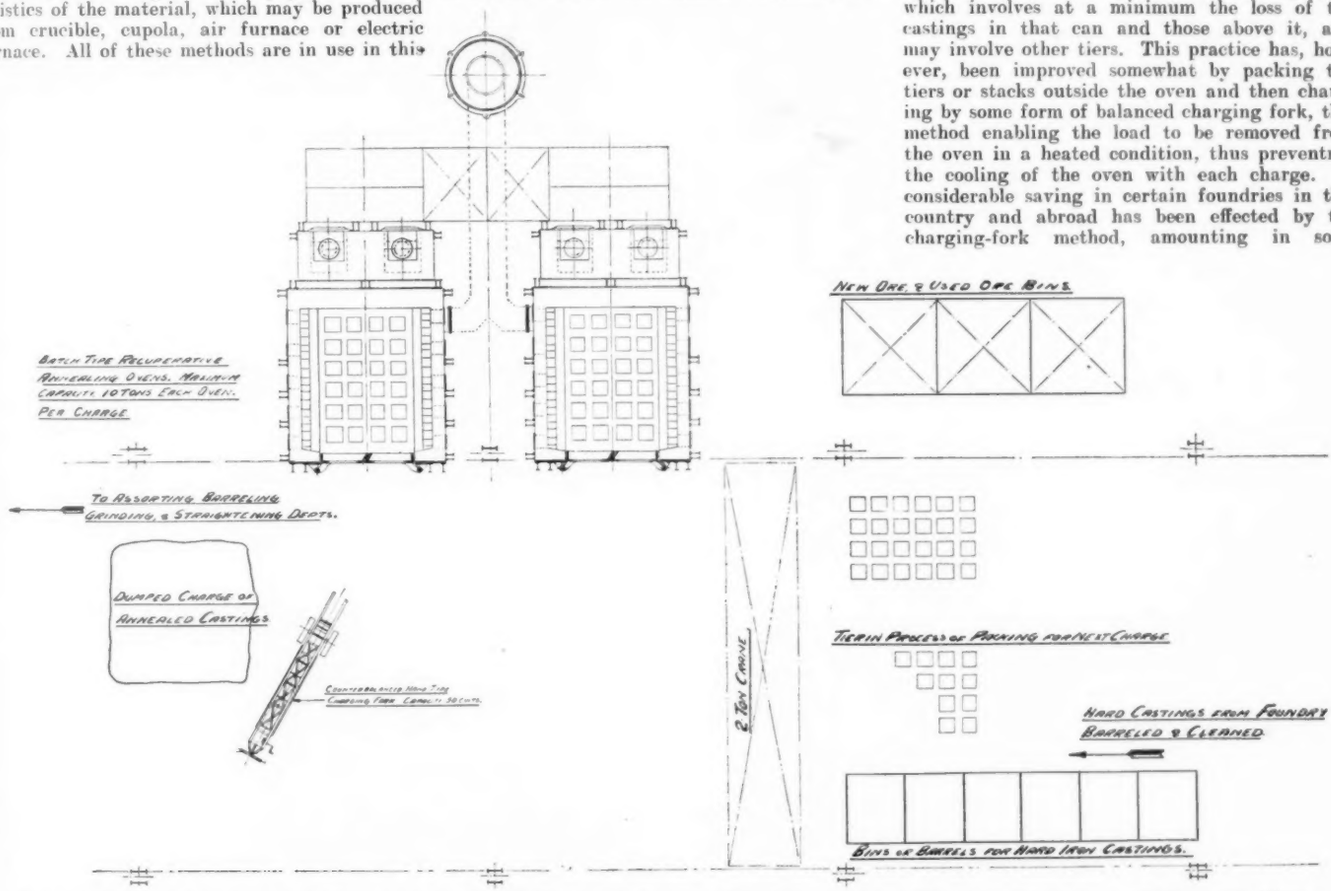

BATCH TYPE RECUPERATIVE ANNEALING OVENS. MAXIMUM CAPACITY 10 TONS EACH OVEN. PER CHARGE
NEW ORE & USED ORE BINS
TO ABSORBING BARRELLING GRINDING & STRAIGHTENING DEPTS.
DUMPED CHARGE OF ANNEALED CASTINGS
2 TON CRANE
TIER IN PROCESS OF PACKING FOR NEXT CHARGE
HARD CASTINGS FROM FOUNDRY BARRELLED & CLEANED
BINS OR BARRELS FOR HARD IRON CASTINGS.

FIG. 1.—TYPICAL LAY-OUT OF A MALLEABLE ANNEALING PLANT FOR GENERAL CASTINGS, HAVING A MAXIMUM CAPACITY OF 20 TONS PER WEEK.

production of a certain quantity of defective or glass-hard castings. The only method of overcoming such difficulties is by more precise methods of heating, quite apart from the question of fuel economy.

Fuel Considerations.

Various fuels have been used; for instance, over 20 years ago pulverised fuel was used in malleable annealing plants in the United States. At present, coal, coke, producer gas, oil, clean anthracite gas and pulverised fuel are all in use with varying degrees of success. Malleable annealing plants may be found in operation today in which the fuel consumption may vary from 10 cwts. to 3 tons per net ton of malleable castings. Labour absorption in the annealing processes may vary to an even greater extent. It must be recognised, however, that this difference in fuel consumption is not necessarily an index to the economy or wastefulness of the annealing furnace practice, but is controlled to a very considerable extent by the class of castings, the necessary heating cycle, relative weight of castings to gross weight of the charge, etc.

There are many other items having a bearing on the annealing cost, such as pan-depreciation

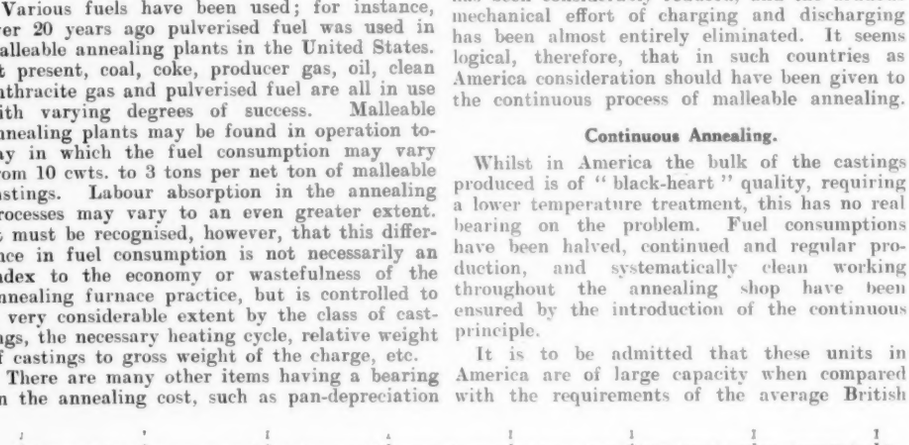


Fig. 2.—Typical Lay-out of a Continuous Annealing Plant for General Malleable Castings, having a Maximum Capacity of 20 Tons per Week.

and efficiency of packing. The problem, therefore, is entirely different from simple annealing questions such as obtain, say, in the annealing of forgings or steel castings requiring a plain heat-treatment on a comparatively short-time cycle. Probably the main factor and difficulty which besets the foundry of moderate size is the fact that a very considerable charge or weight of material is loaded into the oven and that this possibly in some cases represents three or four days' production, or in a smaller type foundry even a week's production—the larger the foundry and the greater the number of annealing units, the more flexible the operation; on the other hand, large foundries usually instal large-capacity ovens.

Organisation Difficulties.

In practice, therefore, ovens containing, say, 5 to 20 tons per charge, after being charged are sealed up and one week later the load is withdrawn and ore, castings and pans are dumped or discharged. In other words, the finishing department of a malleable foundry receives its work in large and irregular quantities; there is no precision or continuity about the process. In these days of mass production, efficient material, tracking, etc., the manager and engineer will appreciate the difficulty in efficiently dealing with this adventitious and irregular production.

It may be well at this stage to review the progress made in annealing problems, dealing with the heavy classes of work in other industries—to cite one as an example, the tinplate industry, the advent of the continuous annealing furnace has reduced the net fuel consumption for double annealing, one annealing at 920 deg. C., and another at approximately 600 deg. C., from 18 to 20 lbs. of coal per basis box, to from 10 to 12 lbs. per basis box; at the same time, labour has been considerably reduced, and the arduous mechanical effort of charging and discharging has been almost entirely eliminated. It seems logical, therefore, that in such countries as America consideration should have been given to the continuous process of malleable annealing.

Continuous Annealing.

Whilst in America the bulk of the castings produced is of "black-heart" quality, requiring a lower temperature treatment, this has no real bearing on the problem. Fuel consumptions have been halved, continued and regular production, and systematically clean working throughout the annealing shop have been ensured by the introduction of the continuous principle.

It is to be admitted that these units in America are of large capacity when compared with the requirements of the average British foundry, but smaller units have been built in Germany and France which have proved highly successful in practice. Fuel consumptions as low as 5 cwts. per net ton of castings are regularly obtained for cupola-cast malleable.

Whilst the time temperature annealing cycle for light and heavy castings does not vary materially in the treatment of black-heart in which the combined carbon is precipitated, in the white-heart or decarburisation process the time required at annealing temperature is determined by the thickness of the casting under treatment, and it necessarily follows that the treatment of any particular charge must be a compromise between the ideal treatment for the lightest and heaviest castings contained therein. The skilled annealer partially overcomes this difficulty by placing the light castings in the coolest parts of the oven and the heaviest castings in the hottest zones.

Increased Flexibility.

From the foregoing it may be argued that to instal one continuous oven in place of several batch or periodic ovens is placing all the eggs in one basket and that a single continuous oven will not give the necessary flexibility and selective treatment necessary to meet the varing demands of practice. It can, however, be clearly demonstrated that the continuous system will give a much greater flexibility in work and selection of treatment than is physically possible of attainment under the most perfect conditions of operation with the batch system.

The volumetric capacity of a periodic malleable annealing oven is usually taken at 60 to 80 cub. ft. per net ton of castings contained in the charge; thus for castings which will nest or pack efficiently an oven 20 ft. long by 10 ft. wide by 6 ft. high, *i.e.*, 1,200 cub. ft., will give a capacity per charge, on the basis of 60 cub. ft. per ton, of 20 tons. An oven 8 ft. by 12 ft. 6 in. by 6 ft., 10 tons per charge and so on.

Figs. 1 and 2 give an interesting comparison of the lay-outs of typical annealing plants for the batch and continuous systems for outputs of 10 and 20 tons per week, respectively, although it must be borne in mind that a continuous oven may be designed to give highly-efficient operating results in capacities as low as 4 to 5 tons per week.

A Comparison of Working Conditions.

Commenting on the foregoing lay-outs, it will be observed that, in principle, the cycle of operation of a batch-oven necessitates the preparation of a full charge of castings before the oven is discharged and re-charged so that at the moment of the latter operation there is for each oven unit a quantity of castings in circulation in the annealing shop equal to two complete charges or 14 days' work on a seven-day cycle of treatment. Assuming that the output of a foundry is divided between two ovens, the process necessitates two weeks' production of castings in the annealing shop. This tends to slow down the process of manufacture and increases the quantity of castings in circulation 100 per cent. as compared with the continuous system.

Assume, for instance, a foundry producing 20 tons of castings per week, the annealing output being handled by two 10-ton ovens, this necessitates 20 tons of castings in the process of annealing in the ovens. There must be at least one full charge for an oven which may be near the point of discharge and also a charge partially prepared for the second oven, together with a quantity of castings which have been dumped from the last oven discharged. In practice it has been proved impossible to work with less than two week's foundry output in the annealing shop.

Speed and Temperature Control.

A continous oven of 20 tons capacity will have one week's work in circulation in the oven, the time required for passage through the oven being seven days, to conform with the same heating cycle as obtained in batch oven heating. A very important point in this connection is that each tier of castings in its progress through the oven is in a progressive state of finish so far as the annealing is concerned, according to its position in the oven, whereas with a batch oven newly charged the whole of the work is held up for seven days. In a continuous oven the daily charge pushed in at the charging end will require seven days for completion, but the castings in the cooling section ready for discharge may only require a few hours, so that the oven, whilst containing a full week's work, has a mean delivery time of 3½ days, *i.e.*, half the total time cycle. Furthermore, the output of a continuous oven per unit volume is greater than the batch oven, as it is usual with the batch oven to cool down considerably, even when the charging-fork method is used, the oven requiring a considerable expenditure on fuel before it reaches equilibrium and saturation at annealing temperature.

With a continuous oven the temperatures may be much more accurately controlled, due to the fact that the oven temperature never varies and is not subject to drastic cooling and reheating. Each section of a continuous oven is properly designed to maintain the heating conditions required throughout the annealing period, thus gradual heating is effected at the point of charging to avoid cracking of brittle castings, and cooling is effected in a specially-designed section so that the heat may be extracted at the required rate, according to composition of the

castings. Furthermore, the live heating section may be continued beyond the ordinary requirements of the oven, so that batches of specially heavy castings may receive longer soak and lighter castings a shorter soaking period. Such variations are obviously impossible with the batch oven.

In practice it has been proved that the actual castings in circulation in the annealing shop are never more than 50 per cent. of the quantity required in batch annealing. Assume, for instance, that a quantity of work is just delivered from the foundry ready for annealing and an oven has just been charged, the next oven may not be charged for four or five days; meanwhile, these castings are packed awaiting their chance at the next oven. Such a condition of affairs is impossible with continuous annealing, each day's output as delivered from the foundry is packed on the furnace trolleys and pushed into the furnace at regular periods and the equivalent daily output is discharged, thus ensuring uniform deliveries to the finishing department and permitting more efficient working and avoiding overtime and rush methods which are so often practised in order to recoup some of the waiting or lost time inherent in the batch system of operation.

Pan-Depreciation Affected.

Quite apart from the obvious savings effected due to reduction of castings in circulation, more regular and efficient operation in the finishing department, saving in labour, space, handling mechanism, etc., and the improvement in the quality of castings produced, a very drastic saving is made in the fuel consumption and pan depreciation. It is a curious and interesting fact that the pan depreciation varies in direct proportion to the fuel consumption and with the low fuel consumptions obtainable with the continuous system, *i.e.*, for "black-heart" castings 5/6 cwts. per ton and for "white-heart" castings under 10 cwts. per ton, depreciation of pans is reduced in like proportion.

A further advantage of the continuous system is that the scale deposition from the pans is carried out of the oven by the bogies, thus ensuring that the furnace system is always kept clean; there is no possibility of choking and clogging of ports and gas passageways, etc., which often necessitate prolonged shutdowns with many types of batch furnaces.

In conclusion, it may be said that the cost of installation of a continuous oven in any malleable foundry producing 5 tons and upwards per week will, without question, show a greater return on capital expenditure than any other investment which can be made in a malleable foundry. The annealing process, which is the most costly and troublesome phase of malleable-casting manufacture, can be reduced to a systematic, efficient, precision and trouble-free basis, and at the same time effect savings equal to at least 66 per cent. of the costs obtaining in what may be considered really efficient batch-operated plants.

Continuous malleable annealing furnaces lend themselves to various methods of heating, with coal, coke, producer gas, oil or electricity, but, generally speaking, a furnace fired by bituminous coal, natural draft, will give the lowest operating costs, but not necessarily the best metallurgical control.

Crystallisation in Ingots.—To obtain an insight into the crystallisation taking place in ingots, R. G. HEGGIE, as described in the "Transactions of the Faraday Society," has studied the solidification of stearine at different initial temperatures and using moulds of different shapes. The rate of solidification is determined largely by the shape of the mould as found with square and circular moulds, while any vibration or shaking of the mould affects the texture of the solidified material. Further experiments were conducted with pure metallic tin and similar observations were made.

Outlook for Copper.

By "ONLOOKER."

During the past few months the copper situation has undergone a complete metamorphosis, for, from a position when nobody could foresee anything in the future except a still further decline to a level well below 5 cents, this metal has become quite a favourite with speculators, and the shares of copper-mining companies all over the world have advanced in an almost spectacular manner.

Even before America had taken the revolutionary step of departure from the gold standard there were signs that a change was coming, for the reports that curtailment at 20 per cent. of capacity, or even lower, would be continued, acted as a spur to the market when it was drooping as a result of the break-up of Copper Exporters. Reports of an impending shut down of North American mines was a further "bull" point, but actually this step has never materialised, although discussions about this vexed question have continued spasmodically during the past few months, and the more optimistically minded have continued to hope against hope that something would be done.

Actually, of course, a fair number of mines in the United States have closed down, and it is more than likely that many of them will never be reopened, for it will be many a long day, if ever, before the world sees 18-cent copper again. However, the fillip given to prices by divorcing the dollar from gold and the spur to optimism provided by President Roosevelt's inflationary tactics have settled—for the present, at any rate—all idea of a shut down, for somehow a "prosperity programme" does not fit in with turning thousands of miners away from their work, and two American mines, at any rate—viz., Utah and Nevada—are certainly earning profits with the red metal at around 9 cents. Official figures relating to stocks, production, etc., are still absent, but there can be no doubt that the position has improved during the past six months, and a recent estimate suggests that reserves of refined have been drawn upon to the tune of 30,000 tons in the course of one month.

American production is certainly cut to the bone, and certainly does not exceed 20,000 tons per month, while it may be rather less, so that if consumption is reckoned at only 40,000 tons, it is easy to see that inroads are being made on stocks. The trouble is, however, to know how much of the copper passing into fabricators' hands is on account of orders received and how much is being taken up to fill in the gaps made by letting stocks down to a minimum. Doubtless, a proportion of the buying has been on this account, but all American reports indicate that an improvement has taken place in the brass-fabricating plants, and there is every reason to suppose that this will continue. Outside the States the growth of consumption has not been so marked, but, on the other hand, the decline in the use of copper was more marked in America than in the Old World, and one could not expect that the improvement would be so noticeable. Although an appreciation in value from the lowest point touched by copper has been seen, the metal still stands at a price sufficiently low to make its use attractive by comparison with other and rival metals, and so long as the climb is not carried too far, consumption ought to be well maintained.

Reference has been made briefly to curtailment of production, but it is also necessary to look at the other side of the picture and consider what is being done by way of increasing output. For the most part producers all over the world stuck rigidly to the 20 per cent. arrangement during the first three months of this year, but since then some expansion has taken place which may well be carried further. Canada has been obliged to speed up nickel output, and this has reacted on copper supplies, which, as a by-product, have naturally increased too; Chile has increased production slightly and Katanga is making plans to follow this lead, although it is doubtful if this additional tonnage will amount to very much. Rhodesia's plans for the future are revealed to some extent by the announcement that the Mufilira property will be opened before the end of this year, and apart from this it is generally understood that output at mines such as Roan and Rhokana is being speeded up.

The world's low cost properties are on the whole, therefore, increasing their rate of output, but profits are as important to them as to any other mining concern, and it may be taken for granted that they are not likely to do anything to prejudice the statistical position and bring down the price. For the moment the market wears rather an uncertain appearance and the quotation has declined below 9 cents, but the outlook is not unfavourable, and later in the year there is every chance that 10 cents will be reached. In the interim period fluctuating markets are likely to be seen.

Torsion Impact Tests.

At a meeting of the American Society for Testing Materials, held at Chicago recently, MESSRS. G. V. LUERSSEN and O. V. GREENE read a Paper on "The Torsion Impact Test," in the course of which they pointed out the need for a reliable method of determining impact resistance on very hard materials such as hardened tool steel. The Paper reviewed briefly the work of previous investigators in this field, and commented on the inadequacy of present impact methods when applied to these materials.

A machine and method especially adapted to hard materials, in which the specimen is fractured torsionally under impact, were described in detail. Calibration of the machine, design of the test specimen, effect of velocity and reproducibility of results were then discussed, and comparisons were drawn with current methods of test on softer materials.

Test data were shown on three hardened tool steels drawn over a range of hardness. These were discussed briefly, and general conclusions were drawn on the practical value of such data and the utility of the machine as a control and research instrument. We append the authors' conclusions.

In view of the results presented, concluded the authors, it is felt that the previous methods of impact testing on hard materials have not always yielded results indicative of the true impact resistance of these materials, on account of variable stress concentration resulting from the character of the specimen and load application. It is believed that the torsion-impact method described not only obviates these difficulties, thus providing a means for making comparisons of impact values, but also operates with an accuracy and ease commensurate with standardised methods used on softer materials.

The test data presented on three different types of steel indicate some very important and fundamental characteristics in hardened tool steel, a more complete knowledge of which should make possible a more intelligent study of tool problems in two ways:—(1) Through the selection of a proper tool steel both from the standpoint of analysis and timbre; and (2) through the use of heat-treatment methods designed to bring out the best properties of the steel selected.

It is therefore felt that the results presented will open a field of testing not hitherto explored in a quantitative way, and should be a means of assisting those interested not only in hardened tool steels, but in other hard materials as well, in more definitely laying out their requirements.

Foundry Selling Practice.

By Eric N. Simons.

A certain foundry sales manager, asked one day by a friend how many salesmen he employed, answered: "Twelve." His friend contradicted him with the statement that actually he employed three hundred; which was the total number of his employees. And there was more than mere smartness in the phrase. Everyone is, of course, familiar with the theory that workpeople can advertise their employment by virtue of the benevolence with which they are treated and their persistence in talking about it. But the substance of this article is concerned with something more tangible and practical than this. The foundry in these days has to aim for something more immediately beneficial to sales than the good opinion of the man in the street. It remains a fact, nevertheless, that the employee or certain employees can be on occasion as good as a salesman, and as important as a market investigator, and there are opportunities galore wasted by foundries in this country simply because they do not recognise this fact. It is still the fashion to believe that all selling of castings is done by foundry salesmen, sales managers, publicity experts, and directors. These people, of course, encourage this belief, for obvious reasons. But far more selling than foundries like to admit is done by employees. It is done, for the most part, casually; but there is no reason why it should not be done systematically. Employees can be taught to consider themselves as salesmen and to act accordingly. There are dangers and difficulties, but these can be overcome.

The Salesman-Buyer.

Let us take, first, staff employees. When examination is made, it will be found that a percentage of all staff workers employed are from time to time in contact with outside firms, many of whom will be potential or actual customers for the castings produced. Take the buyer, for example. It may be argued that the buyer only sees salesmen, and salesmen cannot place orders. The inference, even if this statement were 100 per cent. accurate, is incorrect. People who solicit business from the buyer often own their own works and act as their own salesmen. Salesmen are often accompanied by their directors, for the purpose of bringing a little extra pressure to bear. Such persons are susceptible to approach from a sales point of view. As an indication of opportunities wasted, one may inquire how many foundry buyers are taught to introduce directors of firms who visit them to the sales manager; how many proprietors of small businesses that may yet use castings are allowed to leave the buyer's office without a catalogue or the promise of a catalogue; how many buyers take the trouble to ascertain from their statistical departments which of their suppliers are also customers. The probability is that in many foundries the buyer is left to get on with the job of buying, and has no contact, or very little, with the sales department.

Even ordinary salesmen can transmit sales arguments of a contra-account character to their principals, if urged to do so by the foundry buyer. But this is not all. Quite often it becomes necessary for the buyer to visit a supplier's works. If he is to do the best he can for his firm, he should at once become, for the time being, a salesman. In other words, he must keep his eyes open for possible uses for his firm's castings, try to meet the person responsible for ordering them, and even if he does not poach on the legitimate salesman's activities by trying to sell direct, he can at least ascertain whether the salesman calls, whether he sees the right man, and possibly obtain an appointment or permission to call for him.

But not only the buyer goes into outside works. Engineers in charge of jobs, the practical men who have to go over to deal with complaints or to discuss technicalities, become also, for the time being, salesmen. They, too, can keep their eyes open for possibilities in regard to other types of castings than those they are actually handling; can meet the responsible men; can be enthusiastic in praise of their firm's goods, and can arrange that catalogues shall be sent or a salesman call. Similarly, fitters, erectors, men sent to superintend this job or the other at the customer's works, can, if coached beforehand, do a good deal of spade-work for the sales department. They do this work, as before-mentioned, by talking sound practical sense about the castings and the foundry's products; by finding out all they can tactfully of the scope for further orders, and by making themselves and their work popular with the people about them.

Busmen's Holidays.

So far opportunities that arise in the way of business for employees to make themselves salesmen have been discussed, but there are opportunities that arise in the way of pleasure, and here even the humblest office-boy, if told how, can make himself useful to his employers. In a recent instance, an employee on holiday formed one of an organised charabanc excursion which, after miles of scenery, finished up with a visit to an important works. This employee, during the course of his tour of the shops, got into conversation with this man and that, discovering numerous instances in which his firm's castings might be used, and when he returned from his holiday, went straight to the sales manager and told him all about it. The result was, later, a call from the salesman and an eventual trial order. Employees, again, often have relations working here, there, and everywhere; how often in British foundries does it happen that the sales manager suggests to these people that they do what they can to find out openings for castings by writing to their relations or reporting any information not of a confidential character that their relations send them? I should imagine this happens but seldom. Yet I know of one instance where a foundry was put on to one of its best accounts through the efforts of a junior clerk whose brother happened to have a good position in another town.

The Ex-Employee.

Employees themselves migrate, and in their humble way can often be useful as sources of market information. Much depends on the spirit in which they have migrated. If definitely antagonistic to the foundry that formerly employed them, they are unlikely to be of much help; but if their relations with their employers remain friendly, they can do a great deal. It frequently happens to the vice-chairman of one large foundry in this country to receive letters from former employees who remember him in a less authoritative position, reading somewhat after this fashion:—". . . They were having trouble in our malleable department with bad castings, so I put in a good word for the old firm, and you will have seen a trial order by now. This is just to show that I have not lost my affection for the old firm and all my colleagues at—— "

A good notion is to give to every member of the staff, important or unimportant, an alphabetical list of the firm's products, and, if this can be done, a list of potential uses in various industries. This should be got up in small compass and permanent or semi-permanent form, and the recipients should be urged to keep it about them and refer to it whenever an opportunity arises of visiting other works. The managerial staff, who regularly visit outside concerns should, as indicated in a previous article, be given price and data books identical with those supplied to salesmen and agents.

The dangers of stimulating sales enterprise and enthusiasm among employees generally are not numerous, but very real. An excess of praise or sales talk can very quickly produce an effect of artificiality, even of a breach of hospitality. Tactlessness may do harm. The salesman for the particular firm visited may be rubbed up the wrong way by the manner in which the information is passed on to him. He may assume that there is a suggestion of negligence on his part. These dangers, however, can easily be overcome by the exercise of wisdom on the part of the sales manager, or whoever has the task of producing this "sales-mindedness" among employees. Another point that arises is whether any tangible reward should be given to employees who help to make new contacts in this way. Personal opinion is decisively in the negative. One does not want employees streaming all over the place trying to earn a bit of extra money by badgering unfortunate works officials to buy the foundry's castings. If an employee will not do this much for the firm that employs him, for his own sake to some extent, but also out of loyalty, he will not do it as it should be done because there is a bonus for him at the end of it.

But there is another class of opportunity which does not comprise actual personal visits to outside works. This is the social contact by individual employees with members of other firms. On the golf course, on the tennis court, at the sea, on a liner, in trains, there are endless possibilities of establishing friendships that may ultimately prove beneficial. Usually the importance of such contacts as they affect directors, sales managers and salesmen, are recognised. But sometimes the accidental meeting of two foremen on Blackpool beach can lead to more orders than a hundred rounds of golf with a company chairman. Make the foundry employees see themselves as men who can increase the foundry sales. It will not be effort wasted.

Deterioration of Coals in Storage.

In their Annual Report, the Midland Coke Research Committee have included a paragraph dealing with the deterioration of coke on storage. This paragraph reads: "The effect of storage on the swelling power has been studied. It has been shown, both by small-scale laboratory tests with storage of coal as a powder, and by large-scale tests with storage of coal as 'slack,' that coal from the Silkstone seam can be stored for a period of one year without deterioration of its coking properties. Actually, an increase in the swelling power of this coal is found during the first four months of storage, and a better coke is made from it in the experimental oven during this period. The laboratory tests showed that only coals of over 85 per cent. carbon content (on the dry ash-free basis) did not deteriorate. Coals of lower carbon content decreased in swelling power continuously with increase in storage time, the rate of decrease being greater the lower the carbon content of the coal. The deterioration of some Derbyshire coking coals in practice is such that even a short holiday week-end may cause difficulties. A study is being made of possible 'inhibitors' of the oxidation reactions that cause the deterioration.

"The effect of the size of coal stored on the deterioration was also studied, it being shown that the larger the coal the slower was the decrease in swelling power."

Examinations in Foundry Practice and Science.

SYLLABUSES FOR 1933-1934.

The Advisory Committee of the Institute of British Foundrymen, with which the City and Guilds of London Institute co-operates, has approved of the following scheme of syllabuses for a Three-Year Grouped Course of instruction in Foundry Practice and Science, at the end of which a student should be prepared to take the examination of the City and Guilds of London Institute.

In order to be eligible to enter for the Institute's examination a candidate must—

Either (1) be certified by March 15 by a responsible officer of a Local Education Authority in Great Britain or Ireland, or of a Technical School or College, or of a Works School in these countries—such Works School being specifically approved for the purpose of this regulation by the City and Guilds of London Institute—to have attended satisfactorily during two years prior to the examination (*a*) a course in Drawing and Calculations, extending over a minimum of 50 hours per annum, and (*b*) a course in the technical subject, also extending over a minimum of 50 hours per annum, and to have made satisfactory progress in the (*a*) allied and (*b*) technical subjects during that time.

If, however, owing to residence in a district where such courses, or any of them, are not available within reasonable distance, or for some other valid reason arising from circumstances beyond his control, an intending candidate is unable to obtain certification as required above, he should apply, in respect of the course or courses which he has been unable to attend, to the Institute of British Foundrymen, Saint John Street Chambers, Deansgate, Manchester, or should ask a Local Education Authority to apply to that Institute on his behalf, on or before February 1, with a statement of the circumstances of his case, and with a request that he may be recommended to the City and Guilds of London Institute for acceptance for the ensuing examination: if the candidate is recommended by the Institute of British Foundrymen not later than February 28, he will be accepted for examination by the City and Guilds of London Institute.

Or (2)* be 21 years of age or over on March 15 of the year in which he is to be examined, and be recommended to the City and Guilds of London Institute for acceptance for examination not later than February 28 by the Institute of British Foundrymen, to whom application, with a request for the required recommendation, must be made by the candidate or by a Local Education Authority on his behalf on or before February 1.

The certificate required by each candidate under (1) must accompany Form 18 or 18 E, upon which requisition is made for question papers.

The examination to be held by the City and Guilds of London Institute will comprise *two question papers*, each of three hours' duration and to be answered in writing or by drawings or sketches, the *first* on Foundry Practice and Science, and the *second* on Drawing and Calculations for Foundry Workers.

The Certificate of the City and Guilds of London Institute awarded to a successful candidate will be countersigned on behalf of the Institute of British Foundrymen by the President of that Institute for the time being.

Note for the Guidance of Teachers and Organisers of Foundry Courses.

The subjoined syllabus is intended solely to indicate the matters upon which the questions set in the examination of the City and Guilds of London Institute may touch; it is not to be taken as indicating in any way a suggested class treatment during the three years of the Course, which is assumed to be taken on two or preferably three evenings per week during the normal session.

The syllabuses in Drawing and in Calculations call for no comment. In regard to the syllabus in Foundry Practice and Science the following notes may be helpful:—

The first two paragraphs may well have been covered in a preliminary course. It will be obvious that many of the remaining sections might form the basis of a highly technical course suitable for foundry managers. It is felt, however, that all of them are equally fitted for the simple and elementary treatment which is expected in the course for foundry workers. It is suggested that the work should be experimental where possible, that descriptive teaching should be made realistic by foundry work or foundry visits, that experimental work itself should be qualitative rather than quantitative, seeking facts and ideas rather than mere measurements.

The sections may be taken in any convenient order. In some schemes of study, for instance, selected portions of almost the whole range of numbered paragraphs might be taken in the first year. In others the order for instruction might keep step with the practical pattern shop and foundry instruction where such is available. Parts of the syllabus might be taken over altogether into the drawing and calculations classes, or would supply useful material for examples (see references in later syllabuses).

Science (pars. 1 and 2) need not be confined to the Preliminary Course or to the earlier portion of the Senior Course. Many of the matters mentioned may be taken, if desired, as they arise from consideration of points in foundry practice, and may be illustrated by experiments using foundry materials.

The earlier sections of the syllabus are based on ironfounding as the most widely practised art, and mention is made later of the special features of malleable iron, non-ferrous, and steel founding. Those parts of the course which deal with general methods should be treated so that the matter can be applied readily to any branch. To some extent a selection of the matter may be made to suit local needs, and examination papers will give a sufficient choice of questions to prevent candidates from suffering disability as a result of this.

SYLLABUS.

1.—*Foundry Practice and Science.*

2.—*Drawing and Calculations for Foundry Workers*:—(*a*) Drawing and (*b*) Calculations.

Foundry Practice and Science.

1.—Oxygen, hydrogen, nitrogen, carbon. Classification of common elements as metals and non-metals. Water. The atmosphere. Action of air and water on common metals. Combustion. Oxidation. Reduction.

2.—Weights and specific gravity. Expansion and contraction of solids, liquids and gases. Temperature. Change of state. Specific heat. Transfer of heat.

3.—Pig-iron; its production and uses in the foundry. Charcoal iron, cold-blast iron, hot-blast iron. Cupola-refined and open-hearth refined iron. Cast-iron scrap. Steel scrap.

4.—The foundry cupola. Construction and operation. Blast pressure and volume and their measurement. Coke and its properties. Coke ratios. Methods of charging the cupola. The control of cupola melting. Fluxes. Cupola slag. Refractories used in cupola practice. Lining cupolas and ladles. Steel additions to cupola mixtures. Other types of foundry melting furnaces.

5.—Composition of cast iron and influence of constituents upon its properties. Grey, white, and mottled irons. The composition and grading of pig-iron. Melting losses. Making up the cupola charge. Alloy cast irons. Types of irons used for different classes of castings.

6.—Moulding sands; strength, permeability and other properties. Influence of size and shape of grain, moisture content, and ramming density on strength and permeability and other properties. Red, yellow, loam, river and rock sands as illustrating British natural sand deposits. Mixing and conditioning of sands. Sand mixtures in general use. Sand testing. The use of coal dust, blacking and parting powder. The venting of sands. Defects due to moulding sand.

7.—Core-making. Sands used in core-making. Core binders. Core washes and paints. The preparation of cores; cores made from boxes, strickled or swept-up cores in loam and sand. Use of grids, core irons and core barrels. Venting cores; wax vents, cinders. The testing of core sands. Defects due to core sands.

8.—Types of moulds, open and closed. Greensand, dry-sand, skin-dried and loam. Hand tools used in foundry practice. Moulding boxes, drag, cope, wood boxes, snap flasks. Reinforcement of moulds by irons, gaggers, lifters and sprigs.

9.—Ramming, mould joints, drawbacks, runners, risers. Mould gases, venting. Cinder and coke beds with reference to size of cinders, thickness of bed and distance from moulds. Vent pipes and their connection to the bed.

10.—Loam moulding, designing, laying out, and making tackle. Construction of loam moulds. Use of cores to form the outside of the casting. Moulding from skeleton patterns.

11.—Description of moulds for various types of castings, including castings necessitating irregular joints and complicated coring. Examples of simple loam moulding taken from practice. Pouring basins for various classes of moulds.

12.—Pouring the casting. Pressure of metal on mould and cores; weighting and securing the core and mould against movement. Changes occurring during solidification of castings. Methods adopted to reduce stresses during cooling, baring and easing castings. Cores which will yield to contracting metal. Twisting, bending and breaking on cooling, camber, filleting. Spongy and weak places. How contraction and expansion of the casting vary with the nature of the iron.

13.—Effect of mould material on the rate of cooling and on the final constitution of the metal. Heated moulds. Permanent moulds. Centrifugal castings in sand and metal moulds. Chilled castings. After treatment; annealing and softening of castings.

14.—Designs which produce defective castings. Illustrations of right and wrong design. Defects in castings; blow-holes, pellet holes, scabs, swellings, faint-run and cold-shut castings. Salvaging defective castings; burning-on and welding.

15.—Fettling or dressing castings; chipping, grinding, sand blasting, pickling.

16.—Composition of malleable cast iron, malleable ironfounding. White-heart and black-heart processes. Cupola, air, open-hearth, crucible and electric furnaces. Changes in the annealing process. Properties and testing of malleable cast iron.

17.—Composition of cast steel; effect of varying proportions of carbon in steels. Steel founding; special features of melting practice. Open-hearth furnace, electric furnace, Bessemer and Tropenas converters, make-up of charge. Changes during melting and refining. Annealing of steel castings. Special features of the design of steel castings. Steel-moulding sands.

18.—Non-ferrous foundry practice. Metals and alloys in ordinary use, including brass, bronze, phosphor-bronze and aluminium alloys.

* After the Examinations of 1936, Candidates will no longer be accepted under (2).

Die casting. Chill casting. Crucible furnaces; fixed and tilting. Construction and operation. Open-hearth and reverberatory furnaces. Electric furnaces.

19.—The mechanical and physical properties of cast metals and their testing. What can be gathered from fracture.

20.—Lay-out of a foundry. Construction and application of mechanical appliances used in foundry work, pneumatic rammers, mechanical riddles, rumblers, sand-blast, sand-preparing and distributing plant. Construction of stoves and ovens, portable dryers, drying temperatures. Moulding machines. Types used and advantages and disadvantages. Squeezing and jolting machines. Stripping-plate and pattern-drawing machines. Sand slingers. Sand throwers. Pneumatic, hydraulic and electrical supplies in the foundry. Air compressors, fans and blowers, blast pressure and volume gauges. Equipment for continuous production.

21.—Taper and camber in patterns, allowance for contraction. Position of mould joint, loose pieces, drawbacks, stopping off pieces. Prints, size of print for various circumstances. Templates, strickles or sweeps, guides. Pattern construction, lagging, segmental construction, boxing up, relative advantages of alternative methods. Open joints. Use of lifting straps, lifting and rapping plates. Preparation of pattern work for moulding a casting in loam. Patterns for plate and machine moulding. Metal patterns.

2.—(*a*) Drawing for Foundry Workers.

1.—Construction and properties of simple geometrical figures such as triangles, rectangles and polygons. Projection of simple geometrical solids.

2.—Rapid freehand sketching (generally with dimensions) of:

(*a*) Objects to be cast in the foundry (pars. 11-13).
(*b*) Hand tools used in foundry work or apparatus used in foundry science (par. 8).
(*c*) Sections of mould and moulding box showing varying arrangement of patterns, runners, risers, etc. (pars. 8 and 9).
(*d*) Foundry equipment and machinery including cupola and similar equipment (pars. 4, 16, 17, 18 and 20).

3.—Engineers' drawings. Isometric, oblique or orthographic projection of some of the examples in paragraph 2 hereof, which are of widest application in practice.

4.—Drawing or sketching of the arrangement of strickle and brickwork for the production of a loam mould (pars. 10 and 21).

2.—(*b*) Calculations for Foundry Practice.

1.—The four rules in arithmetic applied to decimal and vulgar fractions; mutual conversion of the two types of fractions; averages; ratios; percentages; square root. Examples to be taken as far as possible from foundry practice—*e.g.*, mixing of metal and sand; percentage of iron to scrap; cupola air supply (pars. 4-7 and 16-19).

2.—Areas of rectangle, triangle, circle and combinations of these figures; surface areas; volumes and weights of simple solids. Guldinus' theorem and its application to pipes and cylinders; weights of castings calculated from dimensioned drawings; specific gravity; weights of simple castings in relation to the weights of their patterns; ratio of weights of similar solids; examples on casts (pars. 12 and 21).

3.—Simple formulæ and factors.

4.—Application of mathematics to mechanics.

Force; parallelogram and triangle of forces; moments of forces; application to lifting tackle such as slings and chains; levers; tensile and compressive stress and strain; elasticity; ultimate strength and factor of safety. Hydrostatic pressure, including pressure of molten metal (pars. 12, 18, 19 and 20).

NOTE.—The references after each section refer to paragraphs in the syllabus on Foundry Practice and Science, from which practical examples may be drawn.

PATTERNMAKING.

Note for the Guidance of Teachers and Organisers of Patternmaking Courses.

The syllabus which follows endeavours to set out as concisely as possible the subjects upon which examination questions may touch. In consequence, it will be necessary for teachers to draw up their own extended syllabuses, arranging the matter for purposes of instruction. The order of the examination syllabus should not, for instance, be taken as implying any suggestion that the study of actual simple problems in patternmaking practice should be deferred until appliances and materials have been exhaustively dealt with. Many of the points dealt with in the earlier paragraphs of the syllabus could not, in fact, be grasped by the student without some previous knowledge of the patternmaker's actual task. It is, moreover, recognised that in some institutions much of the class work may have to be taken in common by patternmakers and foundry workers, and that this factor will necessarily affect the order and method of treatment.

It should be noted, further, that the syllabus does not prescribe the study of any specific examples of patternmaking, but is confined to characteristic principles and methods. These, however, will in most cases be best studied in relation to particular patterns and core-boxes. Many of the examples selected for illustration would not, at the Intermediate stage, be too difficult for construction in the practical classes where such are available. Questions on the construction of patterns and core-boxes for stated purposes will be set in the examination, but the candidate in answering these will be expected to support his recommendations with reasons.

It is not essential that the patternmaker should be familiar with the metallurgical aspect of foundry work. It is, however, very essential that he should have a thorough knowledge of the various operations and principles involved in the preparation of a mould. Questions will be set to test the candidate's knowledge on this side. It is therefore desirable that the teacher should refer to the moulding procedure in connection with all examples of patternmaking selected.

Apart from lathe work, which must be understood and practised at an early stage, the use of woodworking machinery is not touched in the Intermediate syllabus but is postponed to the Final grade, when the lay-out of pattern shops can be more profitably considered. Teachers are reminded, however, that young patternmakers frequently have to operate saws and other machines, so that early "Safety" instruction is called for irrespective of examination requirements.

SYLLABUS.

Intermediate Examination.

1.—Patternmaking Practice; and

2.—Drawing, Geometry and Calculations for Patternmakers:—(*a*) Drawing and Geometry, and (*b*) Calculations.

1.—Patternmaking Practice.

1.—Patternmakers' hand tools—cutting and measuring, and their correct use. Theory of action of cutting tools. The care and sharpening of tools.

2.—Contraction allowances for castings of various metals; the contraction rule. Taper; permissible amounts on various parts of the pattern. Machining allowances. Allowances for rapping, blacking on cores, etc.

3.—Pattern-shop sundries; wood, wax and leather fillets and other special materials. Screws, nails, dowels, glass-paper. Application of rapping and lifting plates and lifting straps. Varnishing patterns, distinguishing different surfaces by colours.

4.—Patternmakers' lathes, wood-turning tools, sharpening and care of turning tools. Pattern turning, centres, turning split patterns; face-plate work; re-chucking.

5.—Growth of a tree. Conversion of timber and influence on warping and shrinkage. Seasoning of timber, defects of timber. Characteristics of yellow pine, baywood and other timbers used in patternmaking. Timber trade terms.

6.—Description of types of moulds; open and closed; green-sand, dry-sand, skin-dried and loam. Moulding boxes, gaggers and sprigs. Ramming; runners and risers. Venting moulds. Position of mould joint to simplify moulding and patternmaking. Moulding projections on the pattern; loose pieces, parting down, drawbacks, covering cores. Attachment of loose pieces. Use of stopping-off pieces.

7.—Common defects in castings; blow-holes, scabs, swellings, defects due to contraction and effects of sharp angles. Use of fillets. Warping of castings. Camber.

8.—Preparation of full-size working drawings on wood.

9.—Jointing timber; edge joints, tongue and groove joints. Corner joints, dovetailing and half lapping. Construction of patterns; solid patterns, box construction; open joints, lagging, segment construction. Disposition of timber to reduce effects of warping and shrinking, and to economise material. Construction to facilitate ramming of underside of pattern. Resistance of pattern to pressure of sand during ramming. Appropriate applications and relative costs of alternative methods of construction.

10.—Prints; thickness of print, loose prints, prints to be moulded in top-part; pocket prints; taper on prints.

11.—Simple core-boxes. Design and construction of larger core-boxes; precautions necessary to facilitate core-making, placing core-irons, venting and removal of core. Strickles for core-making. Securing cores to prevent displacement. Chaplets.

12.—Examples of patterns and core-boxes for various types of castings selected from modern practice, including castings necessitating irregular joints and complicated coring. Pattern work for selected castings to be moulded in loam. Relative patternmaking and moulding costs of various methods of producing a mould.

2.—(*a*) Drawing and Geometry for Patternmakers.

1.—Construction, properties and practical applications of common geometrical figures such as triangles, rectangles, polygons, circles, etc.; isometric, oblique and orthographic projections of simple geometrical solids with applications; projection on oblique planes; intersection and development of surfaces with applications to Patternmaking (par. 8).

2.—Rapid freehand sketching (generally with dimensions) of—

(*a*) Objects to be cast in foundry (par. 12).
(*b*) Hand tools in common use by patternmakers (pars. 1 and 4).
(*c*) Patternmaking machinery and tools used therein.
(*d*) Sections of mould and moulding-box showing various arrangements of patterns with cores, runners, risers, etc. (par. 6).

3.—Engineers' drawings of some of the examples above which are of widest use in practice; abstracting cast parts from such drawings (par. 8).

2.—(*b*) Calculations for Patternmakers.

1.—The four rules in arithmetic applied to decimal and vulgar fractions; mutual conversion of the two types of fractions; averages; ratios; square roots. Examples to be taken as far

as possible from patternmaking and foundry practice.

E.g., contraction and taper allowances, mixing of sands and metal, relative productive costs, spindle speeds in relation to shaft speeds, etc. (pars. 2, 3 and 9).

2.—Area of rectangle, triangle, circle and combinations of these figures; surface areas; volumes and weights of simple solids. Guldinus' theorem and its application to pipes and cylinders. The relationship of weights, volume, and specific gravity abundantly illustrated by examples from dimensioned drawings; ratio of weights of similar solids; weights of patterns in relation to weights of castings. Equipment and machinery; output and relative costs.

3.—Simple formulæ constructed and transformed. Use of factors.

4.—Application of mathematics to mechanics. Force; parallelogram and triangle of forces; moments of forces, applications to lifting tackle, such as slings and chains; levers, tensile and compressive stress and strain. Elasticity; ultimate strength and factor of safety; their applications to patternmaking materials, tools and machinery.

NOTE.—The references after the sections refer to paragraphs in the syllabus on Patternmaking Practice from which practical examples may be drawn.

FINAL EXAMINATION.

1.—Patternmaking Practice; and 2.—Drawing and Geometry for Patternmakers.

1.—Patternmaking Practice.

The Final Examination will include more advanced questions in the subjects of the Intermediate Grade, and candidates will also be required to show a knowledge of the following subjects:—

1.—Methods of building up heavy patterns to obtain adequate strength in relation to lifting and rapping points.

2.—Tackle used in loam moulding; plates, spindles, arms, etc. Preparation of strickles or sweeps and part patterns for loam moulding. Indication of section of metal on strickle or sweep. Methods of setting to ensure accuracy. Splitting cores and splitting plates. Strickles and part patterns for sand moulding. Skeleton patterns for loam and sand moulding. Core-boxes for moulds built in cores. Relative costs of various methods of producing a mould.

3.—Ramming boards; oddsides; plaster matches. Preparation of pattern plates and boards. Stripping plates. Mounting patterns. Registering pattern and stripping plates with moulding-boxes. Plate and machine moulding; cost of patternmaking and moulding compared with costs when using loose patterns. General principles of common types of moulding machines. Features in moulding machines which influence design of pattern—*i.e.*, securing pattern plate to machine, size of table, withdrawal of pattern; method of ramming. Patterns on follow boards and metal plates.

4.—Patterns for spur, mitre, bevel, helical and worm gears. Mortice wheels. Setting out of teeth for gears. Patterns for belt and rope pulleys.

5.—Metal patterns, preparation of "originals," contraction allowances. Plaster-of-Paris patterns. Principles of die casting; preparation of dies and permanent moulds.

6.—Use of surface table; setting-up methods. Patternshop machines; circular saws; band saws; planers, trimmers and sanders. Universal woodworker. Care of saws and machine cutters. Cutting speeds. Safety in use of machines.

7.—Influence of design upon the production of sound castings. Use of denseners and chills. Defects in castings which may be remedied by alteration in design. Detailed study of camber. Reducing cost of patternmaking and moulding by simplifying design.

8.—Principles of estimating prices applied to simple patterns and core-boxes. Recording and storing patterns.

2.—Drawing and Geometry for Patternmakers.

1.—Construction, properties, and practical applications of special curves such as ellipse, cycloid, involute, helix. Intersection and development of curved surfaces, including cylinders, cones, etc. Direct and oblique sections (including true shape) of solids and solids of revolution. Development of curves from sections for skeleton patterns, and strickling or sweeping. Drawings for core-boxes.

2.—Rapid freehand sketches (generally with dimensions) of: (*a*) Patternmaking machinery and tools used therein; (*b*) castings from drawings.

3.—Engineers' drawings, including plans, elevations, sectional and part views of complicated machine parts for casting. From given drawings abstracting special part sectional views for patternmaking and coring involving development of curved surfaces and interpretation of solids.

WORKS OF REFERENCE.

Foundry Practice and Science.

TEXT-BOOKS.—"Practical Ironfounding," by J. G. Horner (Pitman. 5th ed. 1930. 10s.); "General Foundry Practice," by A. McWilliam and P. Longmuir (Griffin. 3rd ed. 1920. 18s.); "Practical Moulding," by S. J. Parsons (Routledge. 1st ed. 1923. 8s.); "Modern Foundry Practice," by J. Sharp (Spon. 2nd ed. 1918 [New imp. 1930]. 18s.); "Lectures on Ironfounding," by T. Turner (Griffin. 2nd ed. 1911. 4s.); "Principles of Ironfounding," by R. Moldenke (McGraw-Hill. 2nd ed. 1930. 30s.); "The Principles of Ironfounding," by A. H. Sexton and J. S. G. Primrose (Technical Publishing Company, Limited. 1911. 8s.).

FOR REFERENCE.—"The Manufacture of Chilled Iron Rolls," by A. Allison (Pitman. 1929. 8s. 6d.); "The Modern Ironfoundry," by J. G. Horner (Frowde and Hodder & Stoughton. 1923. 15s.); "Melting Iron in the Cupola," by J. E. Hurst (Penton. 1st ed. 1929. 25s.); "The Metallurgy of Cast Iron," by J. E. Hurst (Pitman. 1st ed. 1926. 15s.); "Notes on Foundry Practice," by J. J. Morgan (Griffin. 2nd ed. 1920. 4s. 6d.); "Modern Foundry Operations and Equipment," by W. Rawlinson (Chapman & Hall. 1928. 18s.); "The Metallurgy of Iron," by T. Turner (Griffin. 6th ed. 1920. 18s.); "Metallurgy of Cast Iron," by T. D. West (Penton Press Company. 15th ed. 1917. 16s.).

Patternmaking.

TEXT-BOOKS.—"Pattern Making," by J. S. G. Horner (Crosby Lockwood. 5th ed. 1925. 18s.); "Pattern Making," by E. M. McCracken and C. H. Sampson (Van Nostrand. 1923); "Pattern Making," by J. A. Shelley (Machinery Publishing Company, Limited. 1st ed. 1920).

PERIODICALS.—Students are strongly recommended to read the annual "Proceedings of the Institute of British Foundrymen," the quarterly "Bulletin of the British Cast Iron Research Association" and the weekly issues of THE FOUNDRY TRADE JOURNAL.

Cast-Iron Manhole Covers and Frames.—The British Standards Institution has issued British Standard Specification for Cast-Iron Manhole Covers and Frames (Light) B.S.S. No. 497—1933, which deals with light manhole covers intended for domestic purposes and not designed to carry traffic loads. This specification will secure for architects and builders a better quality article than has been hitherto generally obtainable, and deals with quality of material, dimensions, weights, galvanising coating, soundness and inspection by the purchaser. Copies of this new specification may be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1. (Price 2s. 2d. post free.)

Heat-Resisting Cast Irons.

CLASSIFICATION OF SERVICE CONDITIONS.

Mr. E. Morgan's Paper,* which was read before the Cardiff Conference, provoked an interesting discussion.

MR. OLIVER SMALLEY said it was difficult to get a clear understanding of what was meant by "heat-resisting cast irons," because of the different service conditions. In the United States they preferred to classify into four sections: The first comprised continuous heat-resisting cast irons, in which scale resistance was of first importance, such as those used in continuous annealing pots and carbonising retorts and pots; the second class, intermittent heat-resisting irons, which were not heated throughout, as for instance, in ingot moulds, chill rolls, where sudden and severe stresses are to be withstood. In the third class there were the chemical heat-resisting castings, such as caustic acid, sulphur, metal and salt pots, where different temperature conditions are encountered from outside to inside and from bottom to top. The fourth class comprised those in which combined wear-resisting and heat-resisting qualities are needed, as, for instance, those used in pipe balls for tube mills, in special internal-combustion engines, hot forming rolls and dies, and so on.

The higher-silicon series, whilst of academic interest, had limitations practically, because of low strength and brittleness. With ordinary low-silicon iron one could obtain fairly good strength hot, which falls rapidly at temperatures above 800 deg. Fah., but even at 1,200 deg. Fah. some of these irons have greater strength than the high Si series at lower temperatures.

The austenitic series containing high nickel were not economical in commerce; 8 per cent. chromium steel could be made in an electric furnace at a lower price, and this has a superior combination of heat-resisting properties.

MR. F. K. NEATH considered that the most important part of the Paper was the summary of growth-promoting factors and the word of caution at the end—which was typical of Mr. Morgan. In order to understand the problem of growth, as Mr. Morgan had said, we must first analyse the position; his analysis, in the Paper, of the growth-promoting factors constituted a very admirable start, for it was only by investigating separately all the possible factors influencing growth and coming to conclusions and trying to work back to first principles that we could possibly understand growth. With regard to the classification of heat-resisting irons, mentioned by Mr. Smalley, no doubt, if the various classes were studied in greater detail, they could be further sub-divided.

MR. E. MORGAN, in reply, said that the classification of service conditions would simplify matters considerably if it were at all possible to carry this out, but one could not proceed further than to the extent of a very broad classification into high- and low-temperature conditions. Each application was really a problem in itself, because, although the same factors might be operating, they rarely operated to the same extent.

With regard to the high-silicon irons of the Silal type, he had already drawn attention in the Paper to their lack of ductility at low temperatures. These irons were proving quite satisfactory in certain high-temperature services where temperature stresses did not enter, but where there was any likelihood of sharp temperature gradients and rapid heating or cooling, such irons had a tendency to crack. It was also very important in making castings from the special alloy cast iron to obtain the right composition and structure, since far less latitude in this respect was permissible with such mixtures than with ordinary engineering irons.

* FOUNDRY TRADE JOURNAL, July 20, 1933, page 31.

XUM

Time Studies in Foundry Work.

By V. Bernard (Technical Manager of the Rosières Foundries).

[French Exchange Paper.]

(*Continued from page 78.*)

It was decided to forgo a methodical study of these factors for the following reasons: For the rails hitherto employed the firm is progressively substituting the standard-section rail[1] weighing 9.5 kg. per metre, laid on oak sleepers

Table I.

Distance travelled.	Observed times in terms of ton-hectometres.
150-m. track good	1.43
398-m. „ medium ..	1.38
100-m. „ bad	1.47

1.15 m. by 8 cm. by 12 cm., the number used per 5-metre section being six to eight, which enables the carrying of a load of 2,000 to 3,000 kg.[2] per axle. The tracks thus constructed stand the traffic to which they are subject without showing abnormal wear or deflection. There was therefore no occasion to institute special tests in regard to them.

The same remark applies to the track appliances, viz., ball-bearing turntables constructed at Rosières, points and crossings of standard types, which give perfect satisfaction. In regard to maintenance it was assumed that the average condition of these tracks might be regarded as satisfactory and as exercising a constant influence on the duration of the haulages. This conclusion is justified by the following preliminary test with a Decauville wagon with a 500-litre tipper, weighing 310 kg. and loaded up to 1,300 kg.

Moreover, in cases where possible defects in maintenance might place any portion of the system in an abnormal condition no longer corresponding to that existing when the measurements were carried out, the firm relies on being apprised of this by the systematic accidents which would be certain to occur (*e.g.*, derailments) or by the observations of the haulage staff.

The gradient factor also was regarded as negligible as regards the entire portion of the system on the west of the route from the enamelling shop to the joinery shop and on the south of the transverse line from the south bridge to the shipping warehouse, as the gradients in these sections are generally below 1/200 deg. A supplementary study is proposed for the purpose of determining the coefficients for correction to be applied to the figures adopted for haulages from the fitting shop to the shipping warehouse, owing to the important variations in level between these two portions of the works.

Similarly, the influence of the curves (radius > 25 m.) has been ignored as a result of the tests recorded in Table I. The unitary time over the 398 m. route (track in medium condition, with several curves and gradients) is, in fact, better than the unitary time over the 150 m. route (track in good condition, straight and level). These results show, moreover, that the measurements are affected by errors, probably owing to the slight variations in speed of the staff observed, which would appear to render the attainment of extreme precision illusory.

Rolling-Stock. — Among the factors liable to influence the time of a transport operation are: the diameter and section of the wheels, the nature of the axle bearings (plain, roller or ball bearings); the diameter of the axles; the lateral play of the wheel-trains in relation to the space between the tracks; the weight and dimensions of the wagon, etc. But, as in the case of the tracks, no attempt was made to make a study of the wagons by considering all their parts individually. It was recognised that such a study had already been carried out and that the commercial types designed by specialists, such as the small Decauville roller wagon of the tipping type, of which the firm possesses a large number, constituted the normal rolling-stock with which it was desirable to compare the various other types of wagon used.

Table II.

No.	Type.	Capacity of tipper of dimensions of platform.	Wheel dia.	Bearings.	Tare.
A	Decauville, tipping type, steel wheels	560 litres	320 mm.	Roller	310 kg.
B	„ „ „ „	750 „	320 „	„	360 „
C	Low-sided platform	1.10 × 2.4 „ ..	470 „	(see fig. 13)	510 „
D	„ „	1.10 × 2.4 „ ..	320 „	Roller	420 „
E	„ „	1.10 × 2.4 „ ..	320 „	„	435 „

The Rosières foundry is, in fact, obliged to employ two types of body according to the nature of the material which it has to transport by rail: the tipping type and the low-sided platform type, but these bodies are mounted on Decauville or similar chassis, the bearings being either roller or plain and the wheels of various diameters. The tare weight of the wagons also varies. As *à priori*, these differences must affect the transport times, the observers have taken the types of wagon at the firm's disposal as essential variables of the problem. Moreover, as the apparent densities of the material transported differ greatly they have added the *rolling load*.

In Table II the principal details of the wagons are given in regard to useful loads varying from 0 to 1,500 kg.

Test Programme.—The drawing-up of this programme necessitates the previous analysis of the operation to be observed. In regard to transport, such an analysis leads to the separate consideration of the starting period, the haulage period at normal speed, the slowing-down period in stopping, and, further, the time occupied on turntables (comprising slowing down, stoppage, the turning movement proper and starting), and crossing a turntable without turning or passing points or a crossing.

The time relating to these various phases ought, of course, to be measured for each wagon and for the different loads, but to avoid the infinite multiplication of measurements it appeared desirable in the first place to determine the normal load per wagon, *i.e.*, the load which corresponds to the most advantageous time in terms of useful tons, and to which it is desirable to approximate in practice in so far as the apparent density of the material permits. In determining the times applicable to starting, haulage at normal speed and slowing down before a stoppage, the following method was employed. On a straight section of track of sufficient length a series of runs A1, A2, A3, A4, etc., 10, 20, 30, 40, etc., metres in length, was pegged out, thus:—

A 1 2 3 4 5 6

The wagon was made to traverse each of these lengths of track in succession from start to stop, and the time taken was measured.

Unlike the corresponding distances, these times are not in arithmetical progression, because each of them comprises three periods: the starting period, during which the speed starts from zero and attains the normal speed; the

Table III.

Tare.	Load in kg. Useful.	Load in kg. Total.	Average observed time in mins.	Time for 1 ton-hectometre in mins. Useful load.	Time for 1 ton-hectometre in mins. Total load.
		Wagon A.			
kg.	kg.	kg.	min.	mins.	mins.
310	500	810	5.20	2.60	1.61
310	700	1,010	5.61	2.00	1.39
310	900	1,210	5.95	1.65	1.23
310	1,100	1,410	6.46	1.47	1.15
310	1,300	1,610	7.17	1.38	1.11
310	1,500	1,810	8.81	1.47	1.22
1st verification measurement on same journey.					
310	1,300	1,610	6.85	1.31	1.06
2nd verification measurement on 150 m. journey.					
310	1,100	1,410	2.45	1.48	1.15
310	1,300	1,610	2.79	1.43	1.15
310	1,500	1,810	4.03	1.78	1.48
		Wagon C.			
510	900	1,410	7.36	2.04	1.31
510	1,100	1,610	7.96	1.81	1.24
510	1,300	1,810	8.22	1.58	1.14
510	1,500	2,010	9.44	1.58	1.18
510	1,700	2,210	12.40	2.07	1.40
		Wagon D.			
420	1,100	1,520	7.55	1.71	1.24
420	1,300	1,720	8.03	1.54	1.17
420	1,500	1,920	9.71	1.62	1.27
		Wagon E.			
435	1,300	1,735	7.65	1.47	1.10
435	1,500	1,935	9.02	1.50	1.17

Wagon B was not tested owing to its close resemblance to wagon A (same chassis and same tare to within about 50 kg.)

1 Flange Rail, depth 60 mm., width of Flange 65 mm.
2 6 sleepers, 2,000 kg. per axle; 7 sleepers, 2,500 kg. per axle; 8 sleepers, 3,000 kg. per axle.

haulage period at normal speed; and the slowing-down period before stopping, during which the speed decreases from the normal to zero.

If we use :

T_1, T_2, T_3, etc., to represent the observant times in effecting the runs A1, A2, A3, etc.

θ_1, θ_2, θ_3, etc., the times which would have been necessary to complete these journeys at the normal speed, and

$t + t'$ the times corresponding, in the periods of starting and slowing down before stopping, to the difference between the normal speed and the average speed during these periods;

We have then the relations :

For journey A1 : $T_1 = t + t' + \theta_1$
,, A2 : $T_2 = t + t' + \theta_2$
,, A3 : $T_3 = t + t' + \theta_3$
etc.,

from which we obtain :

$$T_2 - T_1 = \theta_2 - \theta_1$$

but since $A_2 = A_1 \times 2$ and as the normal speed is constant, we have thus : $\theta_2 = \theta_1 \times 2$, and hence :

$T_2 - T_1 = \theta_1 =$ the time necessary in traversing the distance A1, *i.e.*, 10 m. at normal speed.

Similarly :

$$T_3 - T_2 = \theta_3 - \theta_2 = \theta_1, \text{ etc.}$$

In other words, the difference between the observed times for completing two consecutive journeys from start to stop, is a constant equal to the time necessary for covering the difference in length between these two journeys at the normal speed.

Moreover, we further obtain from the above relations :

$$t + t' = T_1 - \theta_1$$
$$= T_1 - (T_2 - T_1).$$

For a given wagon and for various loads we have thus determined :—(1) The normal speed, from which we can derive the duration of any journey; and (2) the times to be added to this duration in order to take account of the starting and the slowing-down before stopping, as often as such starting and slowing-down may occur during the journey.

culated. This average was then referred to ton-hectometres of useful load and total load. The observed times include the starting and stopping times. No loss of time was registered for passing points, as in practice this operation was effected by one of the two haulers running on ahead without any appreciable slackening in the speed of the wagon, which for the moment was pushed by only one man.

Conclusions.—The most economic total load is to be found as follows: For wagon A (and probably B), 1,610 kg.; for wagon C, 1,810 kg.; for wagon D, 1,720 kg.; for wagon E, 1,735 kg., as regards facility of haulage. For the wagons A, D and E this result is in agreement with expectations, as all their axles are fitted with roller bearings (Decauville or Rosières) and their wheels are identical. As regards wagon C, it must be taken into consideration that the inferior method of haulage (Table II) is compensated by the greater wheel diameter (470 mm. instead of 320 mm.).

On the other hand, if one considers the necessary times for the haulage of one ton of *useful load* over one hectometre, these times alone being of real interest, one has the following figures: For wagon A (tare 310 kg.), 1.32 to 1.43 mins; and the times necessary for the haulage of 1 ton over 1 hectometre for these loads is practically the same: Wagon A, 1.06 to 1.15 mins.; Wagon C, 1.14 mins.; Wagon D, 1.17 mins., and Wagon E, 1.10 mins.

It follows that the various types of wagons tested corresponding to the rolling stock available may be regarded as being practically equivalent as regards facility of haulage. For the wagons A, D and E this result is in agreement with expectations, as all their axles are fitted with roller bearings (Decauville or Rosières) and their wheels are identical. As regards wagon C, it must be taken into consideration that the inferior method of haulage (Table II) is compensated by the greater wheel diameter (470 mm. instead of 320 mm.).

On the other hand, if one considers the necessary times for the haulage of one ton of *useful load* over one hectometre, these times alone being of real interest, one has the following figures: For wagon A (tare 310 kg.), 1.32 to 1.43 mins; for wagon C (tare 510 kg.), 1.58 mins.; for wagon D (tare 420 kg.), 1.54 mins., and wagon E (tare 435 kg.), 1.47 mins., and as one has to transport material which, in one case, requires or allows the use of the tipping wagon (A) and, in other cases, requires the platform type of wagon (C, D, E), one is led to the conclusion

(*Continued on page* 98.)

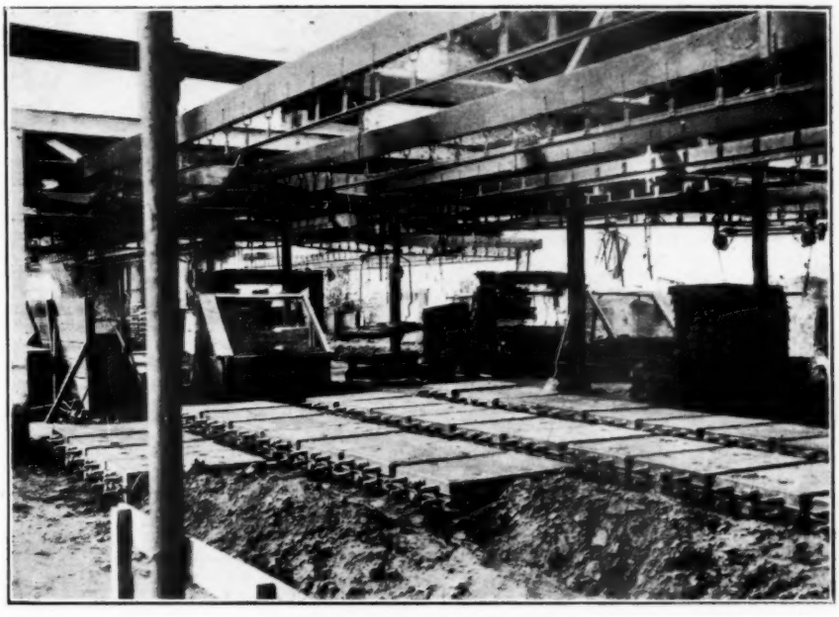


Fig. 10.—General View of a Moulding Shop.

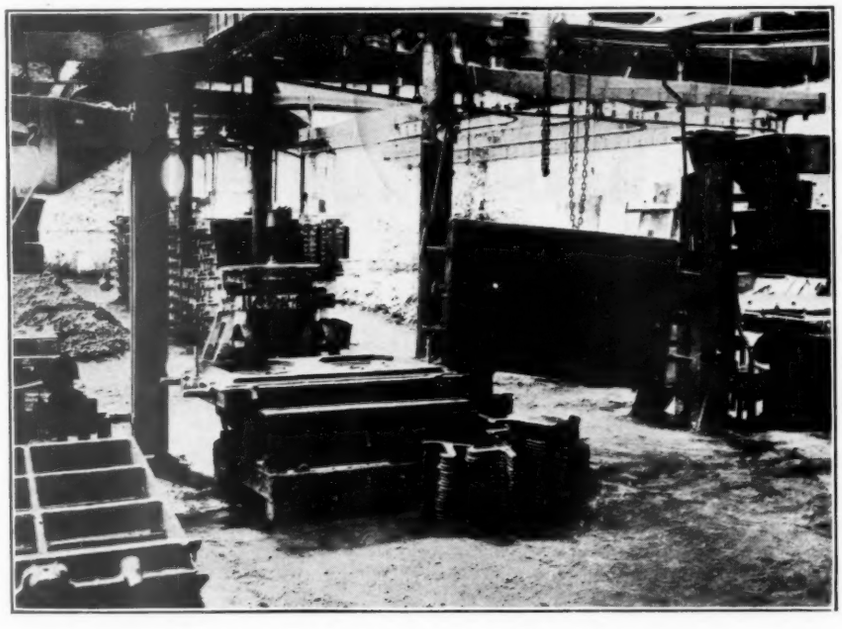


Fig. 9.—Assembly Station serving Two Machines.

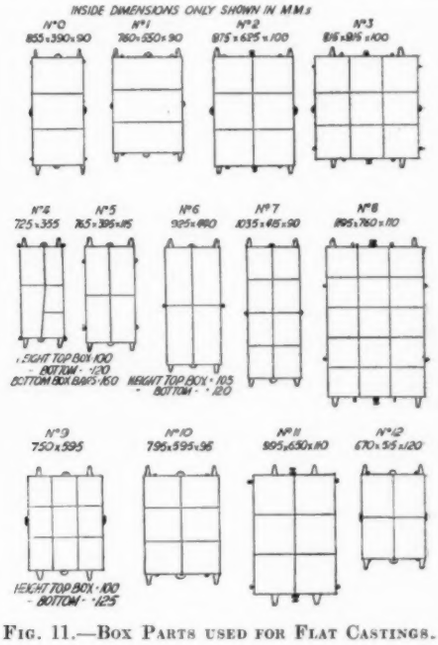


Fig. 11.—Box Parts used for Flat Castings.

Results of the Measurements.

Determination of the Normal Load (or, best, time referred to ton-hectometres) with a given wagon pushed by a team of two men. The tests were carried out over a length of 398 metres. The time required to complete the journey in one direction was measured and then in the opposite direction, the average being then cal-

This Week's News in Brief.

Trade Talk.

The output of new tonnage from Clyde shipyards last month was confined to two vessels, aggregating 3,015 tons.

Messrs. Walter Scott, Limited, Leeds Steelworks, Leeds, have relighted a blast furnace for the production of their "L.S.W." grade of pig-iron.

B.E.N. Patents, Limited, have changed their address to Gorst Road, Chase Estate, London, N.W.10. The telephone number is Willesden 2066.

The Tyne-Tees Shipping Company, Limited, Newcastle, has placed an order with R. & W. Hawthorn, Leslie & Company, Limited, Hebburn-on-Tyne, for a new motor coasting vessel.

The steamer "Adam Smith" (279 tons gross), built at Port Glasgow in 1876, has been sold by Mr. Robert Leeson, of Liverpool, to Scottish buyers, to be broken up at Port Glasgow.

There is a movement in official French foundry circles to organise an International Foundry Congress in Paris in 1937 to coincide with an International Exhibition of a general character to be held in that city from May to October.

The Frodair Iron & Steel Company, Limited, Fenchurch House, London, E.C.3, announce that they have just been awarded a 12 months' contract for the supply of special pig-iron for one of the largest makers of popular motor-cars in this country.

A fleet of auto-gyros are to be built in Glasgow if the tests of the de la Cierva auto-gyro succeed. The auto-gyro was built by Messrs. G. & J. Weir at their works in Cathcart, where others will be built if the machine justifies the hopes of its inventor.

Messrs. Head, Wrightson & Company, Limited, Thornaby, have booked contracts for anti-coal-breakers for loading ships for Messrs. Dorman, Long & Company, Limited, at Port Clarence, on the Tees, and for the Great Western Railway Company, Limited, for Cardiff Docks.

The Steel Company of Scotland, Limited, restarted a number of furnaces and four mills, on August 14, at their Hallside works, Newton. For some time only one furnace has been in operation in the melting department.

There is considerable optimism amongst the founders of Falkirk, and if appearances are not altogether deceptive, it appears that the light-castings crisis has passed the worst. Workers in the local foundries have been kept really busy during the past few months dealing with a mild trade "boom." Though the peak period of the revival may have been attained, it is good to find an absence of suspensions from work of late.

The paddle steamer "Empress of India" has arrived at the yard of the Forth Shipbreaking Company, Limited, Bo'ness, from Leith for breaking up. The Dutch passenger cargo steamer "Eemdijk," of 7,655 tons, built for the Holland America Steamship Company, in 1914, has been beached at the Carriden Yard, Bo'ness, of Messrs. P. & W. M'Lellan, Limited, for breaking up. To fulfil home and foreign orders for scrap metal, about 40 experienced breakers will at once start work on the Dutch vessel.

In connection with the new power station recently completed at Dunston, Messrs. Davidson & Company, Limited, Belfast, were responsible for all the fans for forced draft and for flue-dust collection. These included 48 "Sirocco" electrically-driven fans of the single-inlet type operated by squirrel-cage three-phase driving motors for supplying draft for the twelve boiler units, eight secondary air fans, six "Aeroto" (trade mark) engine-room ventilating fans and 72 "Davidson" patent centrifugal flue-dust collectors, the value of the total contract constituting one of the largest orders ever placed for work of this character.

Messrs. George Brown & Company, Limited, Greenock, launched on August 9 a motor coasting vessel for Messrs. F. T. Everard & Sons, Limited, London. The vessel is of 530 tons, and is 142 ft. long, with a beam of 25 ft. 6 in. She has been named the "Apricity," and is specially designed to carry the maximum amount of cargo practicable for the estuary and up-river purposes. She is equipped with an entirely new type of British heavy-oil engine known as the five-cylinder Sirron, developing 500 h.p. at 300 r.p.m. It is claimed for the new engine that it gives an increased horse-power per cylinder of 40 per cent.

William Baird & Company, Limited, are prepared to spend £500,000 on the modernisation of their Gartsherrie blast furnaces if the Glasgow Corporation agree to their offer to supply 6,000,000 ft. of gas daily for 15 years. The money will be taken from the firm's reserves. The company has always been cautiously managed, and if the directors are prepared to spend half a million pounds on a new scheme, it is because they have confidence in the process they are about to adopt. They are sanguine they can produce pig-iron (provided they can sell gas as a by-product) at lower prices than their Indian and English competitors. The Iron and Steel Trades Confederation are watching developments, as the scheme will afford employment for a large number of ironworkers and miners in Lanarkshire.

An effort is being made by the Amalgamated Engineering Union to alleviate unemployment among Clydeside engineers. They have asked the Clyde Engineering Employers' Association to consider the restriction of overtime and the adoption of the three-shift system in all establishments at present working on a two 12-hr. shift basis. The union points out that a number of firms are working a great deal of overtime, and contends that the three-shift system of eight hours each would spread employment over a larger number of men. The employers have given the union an assurance that they agree with it in its effort to secure employment of the largest number of men, but add the Association has no power to instruct employers except where there is breach of working agreement. They further state there may be technical objections to the three-shift system.

Contracts Open.

Newport, I. of W., August 19.—Supply and laying of a 9-in. water main, for the Town Council. Mr. E. A. Slater, borough surveyor.

Boston, August 22.—Supply, erection, setting to work and maintenance of sewage pumping machinery and electric motors, for the Town Council. The Borough Surveyor, Municipal Buildings, Boston, or Messrs. Silcock & Simpson, 25, Victoria Street, Westminster, S.W.1. (Fee £5, returnable.)

Edinburgh, August 26.—Removal of existing steam and electrical generating plant, and supply and installation of new plant, comprising two Lancashire boilers with mechanical stokers, four steam engines, three generators and all auxiliaries, for the Committee for the Provision, Management and Maintenance of the District Asylum, Rosslynlee, near Edinburgh. The Clerk and Treasurer. (Fee £3 3s., returnable.)

Company Reports.

Clayton & Shuttleworth, Limited.—Loss of £490, increasing the debit balance to go forward to £718.

Haslam & Newton, Limited.—Loss for year to March 31 last, after providing £7,472 for depreciation, of £25,288, increasing the debit brought in to £49,265.

Bengal Iron Company, Limited.—Profit, £48,083; depreciation, £35,482; debenture interest, £60,721; written off debenture discount account, £1,000; debit balance brought in, £112,884; debit carried forward, £162,004.

Time Studies in Foundry Work.

(*Continued from page* 97.)

that, when the tipping type is not possible, one must take the platform type and reduce its tare, if possible to about 350 kg., which the firm is about to endeavour to do.

Owing, however, to the fortunate circumstance that the haulage time per ton-hectometre of *total load* is practically constant for all the wagons, determination of θ and $t + t'$ can be restricted to a single wagon, and the coefficients which are derived from these measurements, by a simple transposition taking the tare differences into consideration, may then be employed for the others.

(*To be concluded.*)

Personal.

Mr. Herbert Watson, foreman of the colliery wheel and axle department at the Rutland Works of Messrs. Samuel Osborn & Company, Limited, Sheffield, with whom he has been for over 55 years, has been presented with a pair of binoculars, a case of pipes, and a framed photograph by the staffs of Rutland Works, on his retirement.

Mr. H. Sherburn, Past-President and also past-secretary of the Lancashire Branch of the Institute of British Foundrymen, has been appointed works manager of Richmond's Gas Stove Meter Company, Limited, Warrington, a branch of Radiation, Limited. He has held several appointments with the Richmond company; for some years he was foundry manager, and was technical manager prior to his present appointment.

Lieut.-Colonel K. G. Maxwell, M.I.E.F., Assoc.M.C.T., M.C., has been appointed manager of publicity of Metropolitan-Vickers Electrical Company, Limited. Colonel Maxwell received his education and early works training in Hobart, Tasmania, and completed his technical training at the College of Technology in Manchester, becoming an associate of the college. He joined the British Westinghouse Electric & Manufacturing Company, Limited, in 1911 as a junior engineer in the transformer department. In August, 1914, he took a commission in the Manchester Regiment after an O.T.C. training, and commanded the 5th Battalion of this regiment during the main enemy offensive of March, 1918. On demobilisation he rejoined the company now known as Metropolitan-Vickers Electrical Company, Limited, and in the research department, under Mr. A. P. M. Fleming, was responsible for investigating insulating materials. At this time British sources of supply were taking the place of pre-war foreign sources, and investigations into the suitability of the British insulating materials had to be made rapidly and thoroughly. The Paper he presented to the Institute of Electrical Engineers, in conjunction with Mr. Alan Monkhouse, gained the Kelvin premium in 1925. Colonel Maxwell has worked as a member of the B.S.I. Technical Committee on insulating materials and on a number of sub-committees, particularly those investigating synthetic resin products and insulating oils, as well as on the Electrical Research Association. He has taken an active part in the selection and training of the Metropolitan-Vickers Company's various grades of apprentices.

Wills.

Sellers, H. M., of Messrs. Darling & Sellers, Limited, engineers, of Keighley	£2,238
Harley, Boston, of Grangemouth, late shipping manager of the Carron Company	£3,036

Obituary.

The death occurred on August 4, at Westfield, Nigg, Aberdeenshire, of Mr. Burnett Gordon, retired blacksmith, at the age of 86.

We very sincerely regret to announce the death last Monday week of Mr. Charles Dufour, who, as we announced on this page a fortnight ago, had just resigned the chairmanship of the French Foundry Employers' Federation, over which he had presided with distinction for 14 years. He had large interests in both the blast-furnace and light-castings industries. He was extremely enthusiastic on the subjects of technical education and industrial research, and both the Paris Foundry High School and the French cast-iron research association owed much to his foresight and personal activity. His association assumed responsibility for the various Foundry Exhibitions staged in Paris, and his efforts to gain serious British participation were worthy of better success, as he, though no linguist, took the trouble to visit possible British participants personally. His recreations were racehorse breeding and shooting. He contributed on two occasions articles on the progress of the French foundry industry in our Annual Review numbers, and his views on the redressing of international trade balances are to-day of even greater interest than when written nearly two years ago. On behalf of the British foundry industry we offer to his relations and friends our deepest sympathy in the loss they have sustained.

Wm. CUMMING & Co., Ltd.,

Ironfounders' Facings Manufacturers and General Foundry Furnishers,

Kelvinvale Mills, Maryhill, Glasgow.

Branches at Falkirk, Chesterfield, Deepfields and Middlesbrough.

The Leading Manufacturers. The Oldest Established. The Most Reliable.

SUPERFINE COALDUST

SUPERLATIVELY REGULAR IN GRIST
SUPERIOR IN QUALITY
SEVEN GRISTS STANDARDISED
ONE QUALITY OF COAL THROUGHOUT

IMPROVED INGOT MOULD BLACKING

THE BEST ON THE MARKET
MANUFACTURED BY THE NEW PROCESS

BRITISH PLUMBAGOS

AT LOW PRICES
IMPORTED DIRECT
NO CONTINENTAL ADULTERATIONS

CORE COMPOUNDS, CUMMINGSTONE, PARTING POWDER, AND BLACKINGS

ALL OF OUR OWN MAKE

USERS OF THE NEW

CUMMING FURNACE

ARE INCREASING WEEK BY WEEK

Wm. CUMMING & Co., Ltd.,

GLASGOW, FALKIRK, CHESTERFIELD, DEEPFIELDS and MIDDLESBROUGH.

Raw Material Markets.

Business has, generally speaking, been at a low level during the past week, the seasonal holidays in the consuming trades being the major cause. Market sentiment has been very optimistic, however, and prices are displaying an upward tendency. Pig-iron consumers are stated to be showing more inclination to enter into forward contracts.

Pig-Iron.

MIDDLESBROUGH.—Deliveries of Cleveland iron to Scotland have not yet reached their normal level, but there continues to be a steady call from local users. A fair number of day-to-day orders is also coming to hand, and the autumn buying promises to be at a better level than for some time past. Considerable deliveries of local pig continue to be made to South Wales. Export prices remain uncontrolled, but there are no exceptions to the rigid observance of the fixed prices of Cleveland pig-iron quoted to home consumers. The prices delivered Middlesbrough are :—No. 3 G.M.B., 62s. 6d. per ton; No. 1 foundry, 65s.; No. 4 foundry and No. 4 forge, 61s. 6d. Two shillings extra is charged on all lots delivered to North-East Coast destinations, 2s. 9d. extra delivered Glasgow, whilst prices delivered Falkirk are 3d. per ton below the Middlesbrough prices.

The South Wales steel industry continues to take heavy deliveries of East Coast hematite, last week's shipments being in the neighbourhood of 2,000 tons. Business generally is at a good level, perhaps owing to the possibility of a rise in prices, as the latter are generally admitted to be very low. However, quotations are still unchanged at 59s. per ton for East Coast mixed numbers and 59s. 6d. for No. 1 grade.

LANCASHIRE.—Judging from the present rate of deliveries of foundry iron into consumption in Lancashire, it seems that, when the holiday season is finally done with, the makers will be in a very satisfactory position. A number of light-castings and textile-machinery manufacturers report better-filled order-books, and forward contracts for pig-iron supplies up till the end of the year are being placed. For delivery to consumers in the Manchester zone, Midland brands of No. 3—Staffordshire and Derbyshire irons—are on offer on the basis of 67s. per ton, with North-East Coast quoted at about the same figure, Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish foundry at about 80s., East Coast hematite at around 74s., and West Coast hematite at 80s.

MIDLANDS.—Founders in this district are moderately well engaged for the season of the year, with the exception of the heavy engineering section, which continues to experience a dearth of orders. The Midland brands of pig-iron are unchanged in price at 62s. 6d. per ton for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffs No. 3, which prices include delivery to Birmingham and South Staffs stations. Continental pig-iron is of no interest to local consumers, the price being too high. There are small tonnages coming through of Cleveland No. 3 at 66s. per ton delivered. The present price for Scottish No. 3 foundry is 85s., and medium-phosphorus pig-iron is offered at from 70s. up to 75s. per ton, low-phosphorus from 80s. to 90s., with refined pig-iron ranging from £5 to £6 15s. per ton, according to analysis.

SCOTLAND.—Owing to the poor state of their order-books, most of the foundries are buying only for their immediate needs, the fixed-price system giving little inducement to forward buying. There is no change to report in prices. No. 3 foundry is still at the official minimum of 65s. per ton f.o.t. furnaces, with 2s. 6d. per ton extra for No. 1. No. 3 Middlesbrough is 62s. 3d. f.o.t. Falkirk area and 65s. 3d. f.o.t. Glasgow area. Midland irons are obtainable at 2s. 3d. per ton below these figures.

Coke.

An absence of forward buying is still noticeable on the foundry-coke market, business being generally slow. Quotations remain as follow :—Best Durham coke, 36s. to 38s.; Scottish low-ash coke, 39s. to 40s.; Welsh coke, 28s. to 45s. per ton, delivered in the South Staffordshire area.

Steel.

The decline in the volume of business which usually takes place at this time of the year is noticeable in all departments of the market. Nevertheless, a confident tone prevails, and there is a general expectation that an active demand will make itself felt in the early autumn. Business in the home market for most iron and steel materials has dwindled, but the inquiry from oversea buyers has improved. Business in semi-finished steel has been negligible since the holidays, and for the time being Continental makers have ceased to press sales in the home market. The British producers have a considerable tonnage of orders on their books for delivery later on, and are in a better position than for many years. In the finished-steel department, the demand from home buyers has declined, but export business, although confined to comparatively small orders, is well maintained. Most of the manufacturers are well off as regards work in hand, and anticipate a revival of activity in the market when the holiday season is over.

Scrap.

Foundries in the Cleveland area are not making a very great demand for scrap iron, but supplies are being disposed of in other quarters, and prices are steadily maintained. Conditions remain unchanged in the Midlands market. In Scotland, the scrap-iron market is now firmer, and first-quality machinery metal is now quoted at 50s. and ordinary cast at about 46s. per ton. The demand is slow in South Wales, except in the case of light metal, for which there is a good call at about 38s. to 39s. per ton.

Metals.

Copper.—There has been a certain lack of interest in this market during the past week, accounting for the comparative steadiness in quotations. The consumption of refined copper in this country fails as yet to show any signs of an increase, although one or two large works, it is true, have been exceptionally busy lately. Generally, speaking, however, users have not been showing much interest in the market during the past fortnight.

The week's prices have been as follow :—

Cash.—Thursday, £36 15s. to £36 17s. 6d.; Friday, £36 13s. 9d. to £36 15s.; Monday, £36 2s. 6d. to £36 5s.; Tuesday, £35 15s. to £35 17s. 6d.; Wednesday, £36 to £36 1s. 3d.

Three Months.—Thursday, £37 to £37 1s. 3d.; Friday, £36 18s. 9d. to £37; Monday, £36 7s. 6d. to £36 8s. 9d.; Tuesday, £36 to £36 1s. 3d.; Wednesday, £36 3s. 9d. to £36 5s.

Tin.—Buying of tin seems to have slackened down temporarily, but this is ascribed largely to seasonal causes. South Wales tinplate interests have not shown much interest, but moderate sales have been made to Continental users. More interest is being displayed in the tin market in America, and consumption in that country is maintained at a fairly good level.

Daily quotations :—

Cash.—Thursday, £216 5s. to £216 7s. 6d.; Friday, £215 15s. to £216; Monday, £215 7s. 6d. to £215 12s. 6d.; Tuesday, £214 10s. to £214 12s. 6d.; Wednesday, £214 17s. 6d. to £215.

Three Months. — Thursday, £216 5s. to £216 7s. 6d.; Friday, £215 15s. to £215 17s. 6d.; Monday, £215 to £215 5s.; Tuesday, £214 to £214 2s. 6d.; Wednesday, £214 12s. 6d. to £214 17s. 6d.

Spelter.—Conditions on the London market are unchanged, quotations maintaining a steady front in the absence of trade buying. It is interesting to note the surprising improvement which has taken place in the spelter situation in the United States. Deliveries of spelter during July amounted to 45,689 tons, compared with about 15,000 tons in January and February this year. In spite of an increase in output, producers' stocks showed a fall of about 15,000 tons

Price fluctuations :—

Ordinary. — Thursday, £16 17s. 6d.; Friday, £16 17s. 6d.; Monday, £16 13s. 9d.; Tuesday, £16 15s.; Wednesday, £16 16s. 3d.

Lead.—A fairly steady business has been transacted in this metal lately, but not a great deal has been to the account of consumers, many of whom at the moment are purchasing only their minimum requirements.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £12 6s. 3d.; Friday, £12 5s.; Monday, £12 2s. 6d.; Tuesday, £12 1s. 3d.; Wednesday, £12.

Papers at the Czecho-Slovak Conference.

The following Papers are scheduled to be presented on Saturday and Sunday, September 9 and 10, at Prague :—

"Recent Developments in Malleable Cast Iron," by J. H. Hruska (American Exchange Paper).

"Inverse Chill," by C. H. Kain (British Exchange Paper).

"Maximum Production from the Cupola," by Dr. Achenbach (German Exchange Paper).

"Air Furnaces: Their Construction and Operation," by J. Buzek (Polish Exchange Paper).

"Steel and Iron Castings," by Dr. G. Storek.

"Cupola Linings," by Dr. H. Spitzer.

"Fine- and Coarse-Grained Iron-Making at Králuv-Dvur," by Dr. Mont. J. Sárek and Dr. F. Vanis.

"Wear Tests on Steel and Iron Brake Shoes and Tyres," by Dr. R. Spacír.

"Accident Prevention in the Vitkovice Ironworks," by A. Vejs.

"The Manufacture of Pig-iron at Vitkovice," by Arm Vlk.

"Influence of Slag on Firebricks," by —. Groh.

"The Strength of Cast Iron," by Navarro Alcarcer (Spanish Exchange Paper).

"Ash Content in Coke," by Dr. A. Altman.

"Tensile Strength and Structure of Cast Iron at Elevated Temperatures," by Dr. A. E. Dobner.

"Quantity Production of Brake Shoes in the Czecho-Slovakian Railway Shops," by J. Egermaier.

"Colloids in Foundry Sands," by Dr. A. Glazunov.

"Rapid Determination of Chromium in Iron and Steel," by Dr. A. Glazunov and J. Krivohlavy.

"Properties of Chill-cast Pig-iron," by L. Humnel.

"A Stricter Definition of the Mechanical Properties of Cast Iron and of Castings," by N. Chvorinov, V. Novy and Dr. E. Valenta.

"Economising on the Gates of Thin-Walled Castings," by E. Kauer.

"Temperature Variations in Moulds and Castings during Cooling," by Prof. Dr. Mont. Fr. Pisek and B. Holman.

"Thermal Treatment of Nickel-Chrome Steel," by Dr. F. Poboril.

"Properties of Foundry Sands at Elevated Temperatures," by Prof. A. Mitinsky.

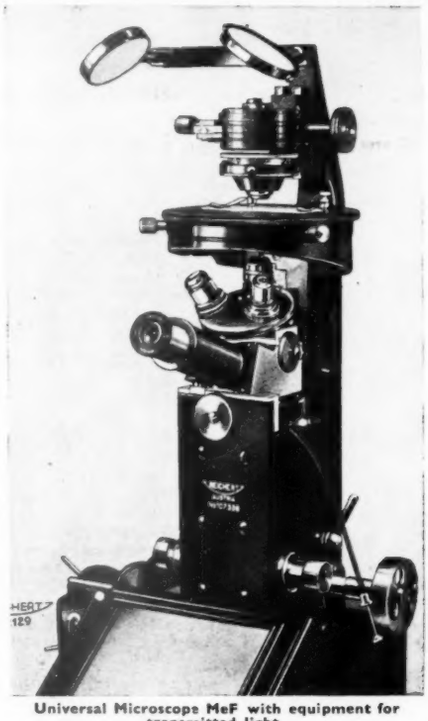
"Influence of the Mixture on the Properties of Rolled Brass," by Dr. O. Rittich.

"Wood for Patternmaking," by Prof. Ryska.

"Cupola Linings," by Dr. J. Robitschek.

"Reactivity and Porosity of Foundry Coke," by V. Samuel.

Sir Percy MacKinnon, chairman of Lloyd's, drove the first six rivets in the keel of the new steamer "Incomati," the third of a series of vessels being built by Messrs. Workman, Clark, Limited, Belfast, to the order of Messrs. Andrew Weir & Company, London and Glasgow. He received 6d. for his services, in accordance with trade-union rate, the money being handed to him by Mr. Phillips, the head riveter. Sir Percy MacKinnon afterwards made a tour of the shipyard.



Universal Microscope MeF with equipment for transmitted light.

SIMPLICITY ITSELF——

If you can operate the shutter release of an ordinary camera no difficulties arise when using

THE NEW REICHERT UNIVERSAL MICROSCOPE "MeF"

with its microphotographic arrangement.

The shutter is situated below the eye-piece assembly ; it is self adjusting for hand or cable release and adjustable for time, bulb or instantaneous exposures. The mirror is removable for cleaning. Dark slides for plate size 9 × 12 cm. with adapters for 6½ × 9 cm. and 4½ × 6 cm. Enlargement of low power general views up to 1½ times the visual observation can be made by utilizing the "Micropolar" photo objectives. Exposures either in transmitted, reflected or oblique reflected light.

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CYLINDER
PIG IRON
"The brand of proved reli
Supplied to specifications covering a wide range of requirements and employed by the leading Railway Co's Roll Makers and Engineering Founders.
CARGO FLEET

RAW MATERIALS—PRICE LIST.

(Wednesday, August 16, 1933.)

COPPER.

	£	s.	d.
Standard cash	36	0	0
Three months	36	3	9
Electrolytic	40	5	0
Tough	38	0	0
Best selected	38	10	0
Sheets	68	0	0
India	49	5	0
Wire bars	40	15	0
Ingot bars	40	15	0
H.C. wire rods	42	15	0
Off. av. cash, July	37	19	0 13/16
Do., 3 mths., July	38	2	3 1/8
Do., Sttlmnt., July	37	19	4 1/16
Do., Electro, July	41	19	6 3/16
Do., B.S., July	40	19	4 1/2
Do., wire bars, July	42	8	6 7/16
Solid drawn tubes			10 1/2d.
Brazed tubes			10 1/2d.
Wire			7d.

BRASS.

Solid drawn tubes	9 1/2d.
Brazed tubes	11 1/4d.
Rods, drawn	8 1/4d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	8d.
Wire	8d.
Rolled metal	7 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN.

	£	s.	d.
Standard cash	214	17	6
Three months	214	12	6
English	215	7	6
Bars	216	15	0
Straits	220	10	0
Australian (nom.)	—		
Eastern	220	10	0
Banca	220	5	0
Off. av. cash, July	216	15	7 9/16
Do., 3 mths., July	216	12	4 1/2
Do., Sttlmt., July	216	15	2 9/16

SPELTER.

	£	s.	d.
Ordinary	16	16	3
Remelted	16	15	0
Hard	14	10	0
Electro 99.9	19	0	0
English	17	10	0
India	16	10	0
Zinc dust	20	0	0
Zinc ashes	4	5	0
Off. aver., July	17	15	10
Aver. spot, July	17	15	10 5/16

LEAD.

	£	s.	d.
Soft foreign ppt.	12	0	0
Empire	12	6	3
English	13	10	0
Off. average, July	13	10	2 9/16
Average spot, July	13	8	2 7/16

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	15	0
Do., V.M. ex-whse.	25	5	0
Rods	30	10	0

ANTIMONY.

	£	s.	d.		£	s.	d.
English	37	10	0	to 40	0	0	
Chinese					26	15	0
Crude					—		

QUICKSILVER.

	£	s.	d.		£	s.	d.
Quicksilver	8	6	6	to 8	13	6	

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 12 6
45/50%	£12 5 0
75%	£18 2 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£25 5 0
4/6% car.	£21 7 6
6/8% car.	£19 5 0
8/10% car.	£18 17 6
Ferro-chrome—	
Max. 2% car.	£30 0 0
Max. 1% car.	£31 0 0
Max. 0.70% car.	£42 5 0
70% carbon-free	10 1/2d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt	5/6 lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under 1/4 in. to 1/4 in.	3d. lb.
Do., under 1/4 in. to 1/16 in.	1/- lb.
Flats, 1/8 in. × 1/4 in. to under 1 in. × 3/8 in.	3d. lb.
Do., under 1/4 in. × 1/4 in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	5	0
Bundled steel and shrngs.	1	17	6	to 2	4	0	
Mixed iron and steel	2	1	0	to 2	1	6	
Heavy cast iron	2	3	6	to 2	5	0	
Good machinery	2	8	0	to 2	10	0	
Cleveland—							
Heavy steel	2	2	6	to 2	5	0	
Steel turnings					1	11	6
Cast-iron borings					1	2	0
Heavy forge					2	10	0
W.I. piling scrap					2	0	0
Cast-iron scrap	1	19	0	to 2	1	0	
Midlands—							
Light cast-iron scrap	1	18	6	to 2	0	0	
Heavy wrought iron					2	5	0
Steel turnings, f.o.r.					1	5	6
Scotland—							
Heavy steel					2	0	0
Ordinary cast iron					2	6	0
Engineers' turnings					1	12	6
Cast-iron borings					1	13	6
Wrought-iron piling	2	2	6	to 2	5	0	
Heavy machinery					2	10	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	30	0	0
Brass	19	0	0
Lead (less usual draft)	11	0	0
Tea lead	9	0	0
Zinc	10	10	0
New aluminium cuttings	72	0	0
Braziery copper	27	0	0
Gunmetal	26	0	0
Hollow pewter	135	0	0
Shaped black pewter	100	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	65/-
Foundry No. 3	62/6
„ at Falkirk	62/3
„ at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	59/6
Hematite M/Nos., f.o.t.	59/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	68/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/-
„ No. 3 fdry.	66/-
Northants forge	58/6
„ fdry. No. 3	62/6
„ fdry. No. 1	65/6
Derbyshire forge	62/-
„ fdry. No. 3	66/-
„ fdry. No. 1	69/-
Scotland—	
Foundry No. 1	67/6
„ No. 3	65/-
Hem. M/Nos. d/d	66/-
Sheffield (d/d district)—	
Derby forge	59/6
„ fdry. No. 3	63/6
Lincs forge	59/6
„ fdry. No. 3	63/6
E.C. hematite	73/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	80/-
Clyde, No. 3	80/-
Monkland, No. 3	80/-
Summerlee, No. 3	80/-
Eglinton, No. 3	80/-
Gartsherrie, No. 3	80/-
Shotts, No. 3	80/-

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	0	0	to 9	15	0	
Nut and bolt iron	6	15	0	to 7	10	0	
Hoops	10	10	0	to 12	0	0	
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to 12	0	0	
Bolts and nuts, 3/4 in. × 4 in.					13	0	0
Steel—							
Plates, ship, etc.	8	15	0	to 8	17	6	
Boiler plts.					8	5	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5 1/2 in.					9	7	6
Rounds under 3 in. to 3/8 in. (Untested)	6	17	6	& up.			
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to 8	10	0	
Fishplates					12	0	0
Hoops (Staffs)	9	10	0	& up.			
Black sheets, 24g. (4-t. lots)					10	0	0
Galv. cor. shts.	„				12	10	0
Galv. flat shts.	„				13	0	0
Galv. fencing wire, 8g. plain					14	0	0
Billets, soft	5	0	0	to 5	12	6	
Billets, hard	6	12	6	to 7	2	6	
Sheet bars	4	15	0	to 5	5	0	
Tin bars					4	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12 1/2d.
Rods	11d.
Tubes	15 1/2d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.34
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	13.00
Basic	17.89
Bessemer	18.89
Malleable	18.39
Grey forge	18.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	40.00
Billets	26.00
Sheet bars	26.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	1.86
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.70
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.10
Plain wire	2.10
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.25

COKE (at ovens).

Welsh foundry	20/- to 22/-
„ furnace	15/- to 15/6
Durham and Northumberland—	
„ foundry	21/- to 25/-
„ furnace	13/3
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box		17/-
„	28×20 „		34/-
„	20×10 „		24/4
„	18 3/4×14 „		17/9
C.W.	20×14 „		16/-
„	28×20 „		32/6
„	20×10 „		22/9
„	18 3/4×14 „		16/6

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to £7	0	0	
Bars-hammered, basis	£16	0	0	to £16	10	0	
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0	
Blooms	£10	0	0	to £12	0	0	
Keg steel	£30	0	0	to £31	0	0	
Faggot steel	£18	0	0	to £23	0	0	
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0	

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Aug.	10 ..	36	15	0	inc.	2/6
,,	11 ..	36	13	9	dec.	1/3
,,	14 ..	36	2	6	,,	11/3
,,	15 ..	35	15	0	,,	7/6
,,	16 ..	36	0	0	inc.	5/-

Electrolytic Copper.

		£	s.	d.		
Aug.	10 ..	41	0	0	No change	
,,	11 ..	41	0	0	,,	,,
,,	14 ..	40	5	0	dec.	15 -
,,	15 ..	40	5	0	No change	
,,	16 ..	40	5	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
Aug.	10 ..	216	5	0	inc.	16/3
,,	11 ..	215	15	0	dec.	10/-
,,	14 ..	215	17	6	,,	7/6
,,	15 ..	214	10	0	,,	17/6
,,	16 ..	214	17	6	inc.	7/6

Tin (English ingots).

		£	s.	d.		
Aug.	10 ..	216	15	0	inc.	15/-
,,	11 ..	216	5	0	dec.	10/-
,,	14 ..	216	0	0	,,	5/-
,,	15 ..	215	0	0	,,	20/-
,,	16 ..	215	7	6	inc.	7/6

Spelter (ordinary).

		£	s.	d.		
Aug.	10 ..	16	17	6	inc.	2/6
,,	11 ..	16	17	6	No change	
,,	14 ..	16	13	9	dec.	3/9
,,	15 ..	16	15	0	inc.	1/3
,,	16 ..	16	16	3	,,	1/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
Aug.	10 ..	19	5	0	inc.	5/-
,,	11 ..	19	5	0	No change	
,,	14 ..	19	0	0	dec.	5/-
,,	15 ..	19	0	0	No change	
,,	16 ..	19	0	0	,,	,,

Zinc Sheets (English).

		£	s.	d.		
Aug.	10 ..	25	15	0	No change	
,,	11 ..	25	15	0	,,	,,
,,	14 ..	25	15	0	,,	,,
,,	15 ..	25	15	0	,,	,,
,,	16 ..	25	15	0	,,	,,

Lead (English).

		£	s.	d.		
Aug.	10 ..	13	15	0	No change	
,,	11 ..	13	15	0	,,	,,
,,	14 ..	13	10	0	dec.	5/-
,,	15 ..	13	10	0	No change	
,,	16 ..	13	10	0	,,	,,

Imports and Exports of Iron and Steel Castings, etc., in July and the seven months 1933, compared with July and the seven months 1932.

	July, 1932.	July, 1933.	Seven months, 1932.	Seven months, 1933.	July, 1932.	July, 1933.	Seven months, 1932.	Seven months, 1933.
Imports.	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Pipes and Fittings, Cast	135	111	1,850	816	1,894	2,335	32,234	15,514
Castings, in the Rough, Iron	7	1	531	45	209	38	9,476	1,718
,, ,, ,, Steel	163	55	1,208	396	3,319	668	23,395	6,498
Hollow-ware, Cast, not Enamelled	8	6	15	18	585	347	1,238	1,433
,, ,, Enamelled	16	4	71	47	458	380	2,328	2,840
Exports.								
BUILDERS' CASTINGS—								
To Argentine Republic	18	2	245	76	536	118	8,979	3,339
,, Irish Free State	266	186	2,426	2,028	11,476	9,771	107,893	85,376
,, British South Africa	93	187	899	1,134	3,402	8,521	32,245	47,514
,, ,, India	46	127	530	624	1,486	3,504	18,210	21,000
,, New Zealand	49	14	188	164	2,120	936	9,251	8,293
Total (including other countries)	762	856	6,658	6,664	31,398	37,693	276,076	272,661
PIPES AND FITTINGS—CAST—								
To Argentine Republic	172	75	1,303	944	1,746	1,022	13,929	10,487
,, Irish Free State	461	414	4,442	3,581	6,522	5,459	61,322	44,846
,, British South Africa	151	1,034	2,731	5,761	1,774	8,067	33,677	50,133
,, ,, India	101	129	709	806	2,219	1,865	12,096	13,231
,, ,, Malaya	37	11	1,497	258	727	195	15,573	3,056
Total (including other countries)	5,489	6,797	40,851	44,934	55,511	61,042	422,594	427,771
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	208	245	1,414	1,868	6,910	7,512	50,412	59,295
,, Enamelled	80	47	477	432	6,726	4,415	40,557	33,928
CASTINGS, in the rough—								
Iron	132	94	637	589	4,251	3,531	23,737	20,753
Steel	43	48	474	566	2,128	1,737	20,604	21,596

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CHARGEHAND Moulder for Iron Foundry (Birmingham area), mainly engaged on light and medium repetition engineering castings. Should have sound general experience as well as plate and machine moulding. Give details of age, experience and wages required. Good prospects for live man.—Box 480, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVES required in Scotland, N.E. Coast, Lancashire, for sale of all kinds of Foundry Requisites and Refractories. High rate of commission offered to those who have the entrée to foundries. None but experienced salesmen in foundrywork need apply. —Box 484, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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POSITION required as Assistant to Foundry Manager by young man aged 23. Practical moulder with cupola, laboratory and D.O. experience and sound technical training. (223)

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THE Proprietor of the Patent No. 210118*. for "Improved Manufacture of Gray Iron," is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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FOUNDRY Transverse Bar-Testing Machine by Avery, for 2-in. x 1-in. Bars, 1 to 3 ft. long, calibrated up to 40 cwts., with deflection scale; in good working order. Price £30 or nearest offer.—Hartley, Sons & Company, Engineers, Etruria.

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Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

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Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.

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24" × 18" Tabor rollover, portable £55
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No. 20 Macdonald plain jolter with 90" × 90" table, jolts 8 tons £160

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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

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